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POWER

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Cleaning Up

WITH the coming of spring, there comes the impulse to clean up.

Outside, the accumulations of the winter are removed and its ravages repaired. Within, workmen ply the various trades that contribute to the annual renovation and house cleaning.

The process is just as applicable, salutary and beneficial to an industrial establishment.

And when it is applied, do not neglect that often obscure and neglected corner where the power generating equipment is housed.

Probably your engineer has called attention to things that could be done to bring his department up in seemliness and efficiency to the productive departments of the business.

It may be that a half-hour spent with him in seeing what his conditions are and how they might be improved would be a profitable venture.

And whether the Boss is likely to come or not, an occasional clean-up is good for the power plant itself.

There is a lot of satisfaction in going through things, sorting them out and getting them into their places.

Long-lost tools and fittings will come to light, forgotten memoranda will turn up, and you will get a new start on a clean slate.

Of course, things ought to be kept always in their places and order ought to be continuous and not spasmodic, but they are not.

There is a grand and glorious feeling in a new start after a good clean-up.

And if the Boss *should* come around, he will appreciate order and cleanliness if he finds it, and be more likely to lend a sympathetic ear to suggestions for improvement.

F. R. Low

Worth While Savings From Power Drives

THE engineer of a certain textile mill desired to change some of his power drives for newer and more efficient equipment. When he took the proposition up with the management, inquiry was immediately made as to the cost of the change and the estimated savings. Figures showed that, for an investment about double the replacement cost of the existing installation, a saving varying from five to twenty-five per cent in power, depending on the load, could be made.

This proposal was turned down by the management, which had a rule that new equipment must pay for itself in two years. It happened that the new drives would have taken, with an average load, about seven years to save their cost.

Undoubtedly, with certain kinds of equipment such a policy pays. But power transmissions are not in that class, for the designs that save power also effect other savings and advantages. Labor for both upkeep and lubrication is less. Maintenance is less. Less lubricant is used. Because of better alignment, less friction and generally improved operation, the life of belting is prolonged. And, finally, the reduction in power consumption effects additional savings in the power house, besides those that can be directly figured from load reduction.

In the case cited, both the management and the engineer were in error. The management should not have made a decision merely because of similarity, treating power equipment as production equipment would naturally be treated. And the engineer should have presented the advantages of the new drives so fully that the real savings would have been evident and the management would have been safeguarded from a wrong decision made on insufficient information.

The Young Graduate

DR. HARVEY N. DAVIS, president-elect of Stevens Institute of Technology, recently forecast the policy of that institution and sounded a worthy keynote for any engineering school.

Stevens Institute is committed to keeping itself small but good, offering more to the capable student, who only will be admitted.

While the Institute gives but one course and one degree, Doctor Davis proposes to emphasize " . . . what is actually the truth, namely, that we are training cadet-engineers, not merely for one branch of engineering, but for all branches of engineering. . . . The granting of this degree does not mean that the recipient knows how to solve the problem of any job, however small, in one field, but it should mean that he knows how to learn how to do so for any job, however large, in any field in engineering.

"We want to instill the research spirit . . . cultivating an attitude which attacks all problems on their merits, and not on the basis of what grandfather said about them . . . to train students to approach subjects with an analytical mind, to see the specific questions which it pays to ask and to ask them of themselves and to seek the answer, whether it is in the book or not."

Just at this season of the year, when the engineering world is being invaded by new battalions of graduates from the technical schools of the country, it is well to consider what they mean to engineering and what engineering means to them.

To the graduates it may be said, do not esteem yourselves too highly. You are but beginners in the world of actual practice. The facts you have learned are perhaps to be useful, perhaps not. The one thing that you should have is full command of a well-trained mind, and with this you can confidently tackle anything. If perchance you have missed this, nothing else will avail.

To the practicing engineers who will work these graduates it may be said, do not expect too much. These graduates have had little or no contact with actual practice. There is much that they do not know. Their training, if it has been any good at all, has been directed to equipping them with a basic grasp of scientific knowledge and methods. Do not judge these men on what they know or what they can do, but rather on their capacity to learn.

And let both young and old remember always that none is perfect, and stand ready to yield a bit when things don't go too well.

Make Elevator Operation Safe

ACCIDENT prevention has become a national watchword. The Safety First movement has been accepted as an economic and humanitarian institution, but it lacks the legislative support that its importance warrants. Even when codes are available that represent the best thought in an industry, it is difficult to have them adopted by state and municipal legislatures. In many cases when a code is made mandatory, it differs from the national standard, and quite frequently it is inferior.

In elevator service the landing doors are responsible for ninety per cent of the accidents during normal operation. Proper interlocks on the hoistway landing doors and car gates would prevent these accidents. Such interlocks are called for in the American Society of Mechanical Engineers Safety Code for Elevators, but a little observation of elevators in various states will show practically no uniformity in these requirements. The few states that are leaders in safe practices require that the hoistway doors and car gate be provided with interlocks that will prevent the car being moved unless the doors and gate are closed and the doors locked. In other states these interlocks are not required, and in others gates are not even required on the cars.

When an elevator car can be moved away from the landing with the doors and the gates open, there exists a hazard to human life. If the car is taken away from the landing and the doors are not closed and locked, someone may walk into the hoistway and in the fall be seriously injured or killed. There is also the danger that a passenger will be jammed between the doors and the car. The prevalence of these accidents on elevators without door and gate interlocks and on machines where these have been installed and have not been properly maintained, shows the seriousness of the landing-door hazard.

One of the objections raised to the use of interlocks is that they slow up elevator service. This, however, is only an admission that the elevators without interlocks on the doors can be moved away from the landings before the doors and gates are closed and can, therefore, be operated in a hazardous manner.

When life is at stake, nothing else counts. Interlocks and car gates are essential to safety.

The Modern Workman Sees the World

NOW and then some wailing Jeremiah bemoans the decadence of the modern workingman to the status of a machine. In past years, the contention runs, each man was master of his own work and his spirit was animated by a keen appreciation of his significance in the great social scheme of things, whereas today, it is held, the individual is rapidly becoming little more than a cog in a great machine of whose entirety, and of his place in it, he has little comprehension.

Is that so? Has the modern worker a less intelligent view of the world than his great-grandfather? True, his work has narrowed down to some more or less minute detail, and the economic structure of present-day commerce is a bit staggering. But what about the automobile? Does that not broaden one's contacts immeasurably? And the movie? Does that not bring the ends of the earth before one's eye? And the radio? Does it not tell a wondrous story of what mankind is doing? And the modern newspaper? Does it not inform its readers of events beyond the confines of their daily task?

Compare the outlook on life of the humblest man of today with that of the most intelligent worker of a century ago. He had little to read. He rarely traveled five miles from his home. He saw nothing and heard little of things beyond his daily round. And yet we are assured that he had a broader view of life and of his place in society's grand venture of conquest.

We doubt it.

Application Patents

AN OBJECTIONAL practice which has developed among European engineers and which threatens to spread in America is that of taking out patents for every conceivable application of standard equipment and machines. Some of these applications are quite obvious, and many have been used in actual machines. The fact that they were obvious common-sense applications of the particular apparatus, never prompted the original users to take out a patent. The Patent Office simply determines whether the proposed scheme has been covered by a previous patent and, if not, grants a patent on the new application. The Patent Office does not concern itself with the fact that the combination has been used before or whether the idea has been common knowledge to certain people. It leaves this matter to be settled by the courts later if such a decision is needed.

These practices are objectionable for many reasons. It is difficult to conceive that obvious combinations of standard equipment are original ideas, and therefore the patent has been granted on a false premise. In the second place, firms making the standard equipment, for business reasons or otherwise, frequently do not care to contest these application patents. Finally, these patents give rise to feelings of injustice in the minds of those who rightly feel that they had a prior conception of the idea, but had not been foresighted enough to apply for a patent.

One can have no objection to the patenting of an original idea covering the application of standard equipment to an entirely new purpose, but engineers should strenuously object to being held up by patents taken out on obvious applications of standard equipment merely for the purpose of collecting royalties from users.

A Great Field for Automatic Power Plants

INDUSTRIES have met with marked success in reducing the productive labor per unit of output, but in the power houses serving these factories it is still felt necessary to have an engineer in constant attendance.

It is the imagined need of an attending engineer that has caused many mills to discontinue the isolated power plant in favor of purchased current. Even though the other items were not high, the pay of an engineer to operate a plant of one hundred horsepower made the power costs excessive.

Since there are many advantages in having the power generation under the mill's control, why are not laborless or automatic power generating plants the vogue?

It requires no great imagination to picture a small steam engine and boiler plant whose operation is carried on with but little attention. Oil-engine plants have been built, that are entirely automatic in operation, including starting at a drop in line voltage and shutting down when the demand stops. There is no reason why such automatic Diesel engines could not be installed to supply factory power.

If the owner does not care to operate his plant as a full-automatic, it would not increase costs much for one of the mechanically trained factory men to spend, say, an hour a day in the engine room.

This type of plant would eliminate a major item of power cost in the small plant. Generating power would merely entail the fuel and lubricating oil charges, and whatever overhead was deemed reasonable. Power could be produced for much under two cents per kilowatt-hour. Very little development of the automatic control devices is needed, for at least one such plant uses standard electric relays and pressure-control switches.

That this is something more than an idle dream will be evident to those who are familiar with recent progress in the hydro-electric field. Full-automatic water-power plants with units as large as twenty thousand horsepower are now in operation. The units are started and stopped automatically by float switches, drop in line voltage, or have supervisory push button control from a distance.

Imagine the Savings!

IMAGINE what a difference it would make in the power consumption and reliability and safety of operation of some industrial plants if speed reductions on production equipment were as well chosen as they are for power generating equipment. Certain plants seem to think that, as long as the machine operates at the correct speed and has a satisfactory output, no attention need be paid to the machine drives.

There seems to be little excuse for such an attitude. Well-designed and highly efficient speed reducers are now marketed by a number of companies. But, too often, production officials fail to realize the benefits that might be derived from their use.

And the management is not quick to see the benefits that might be obtained from the use of modern speed reducers. In fact, the engineer is the only one who does. The most progressive concerns have already placed speed reduction under his care. When the management of the remaining plants do likewise, imagine the savings that will be made!

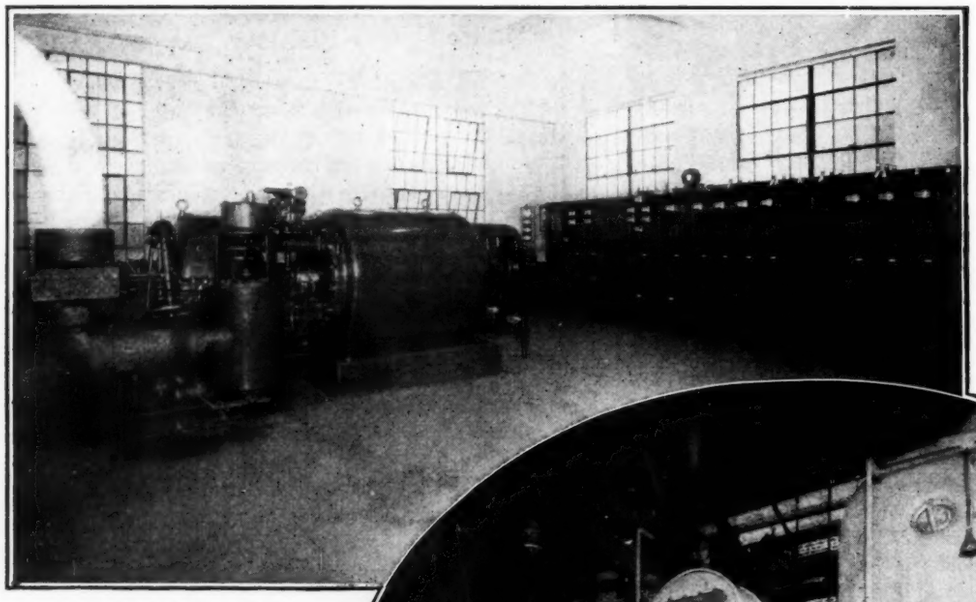


Fig. 1—The 1,250-kw. back-pressure turbine installed

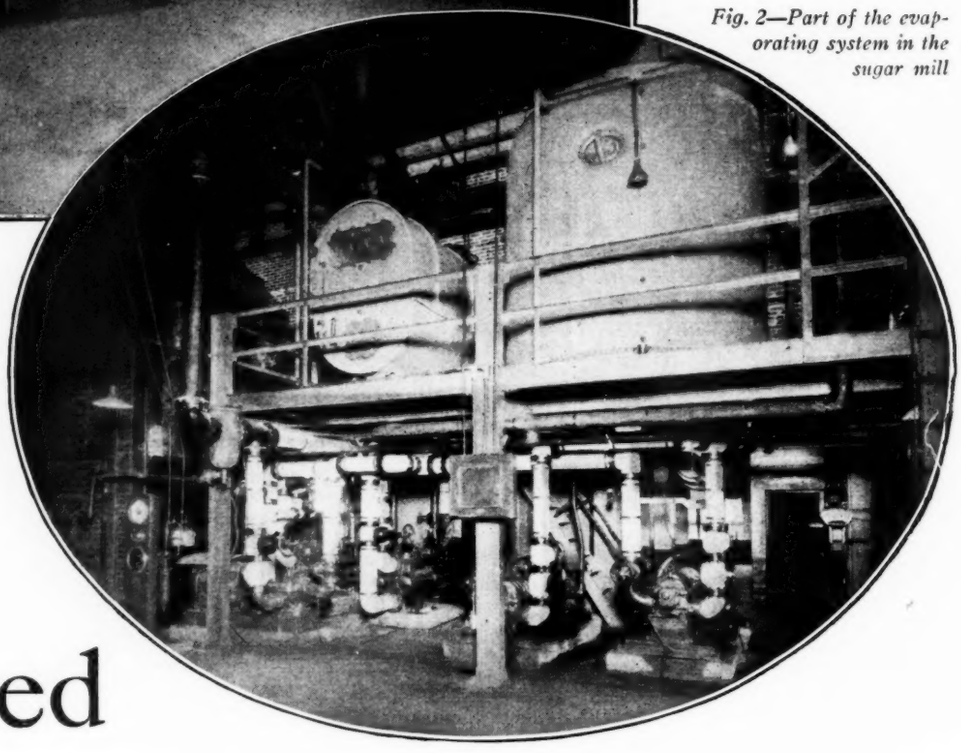


Fig. 2—Part of the evaporating system in the sugar mill

The Isolated Plant Saves Money

By Alex. M. Ormond

AFTER purchasing part of its power for a number of years, the Savannah Sugar Refining Corporation, Savannah, Ga., installed a back-pressure turbine and now obtains its power and process steam at a substantial reduction in cost.

Sugar refining is an industry in which there is a demand for large amounts of process steam. This makes it possible for this industry to generate its own power at a considerable saving over the price that it would have to pay for power from a central station where it is necessary to condense the exhaust, with the resulting loss of latent heat in the steam.

The Savannah Sugar Refining Corporation's refinery, as originally built, produced most of its own power. Provision was made, however, for the purchase of some power from an outside source, and as the plant increased its output the purchase of energy grew to such proportions that it was decided to build a new power plant. As all the exhaust steam could be used in the refining process, power could be produced cheaper than it could be purchased, and the decision was made to increase the capacity of the power plant, abandoning the use of outside current.

This plant has an output of 1,000 tons of refined sugar per 24 hours, and originally held a 200-kw. direct-current, engine-driven generator and a simple belted 26x48-in. Corliss engine. In addition to these engines there were two steam-driven air compressors, a 35-kw. engine-driven generator for charging the storage batteries used on the tractors, and numerous steam-driven pumps.

The purchased energy was used for operating three-phase 60-cycle 550-volt alternating-current motors.

In looking around for precedents to guide one in designing a power plant for a sugar refinery, and after examining the power plants of existing refineries, one is forced to the conclusion that it is better to disregard what has been done before and to work out the problem to meet the particular conditions at hand. Perhaps in no other industry is there such a diversity of methods of producing power. Here one will find generators, both direct and alternating-current, with voltages from 110 to 600. driven by various types of steam engines and turbines operating as back-pressure, extraction and condensing units and with steam pressures varying from 60 to 200 pounds.

The first step in designing a power plant for an industry using process steam is the making of a steam survey. This consists of finding out by means of instruments, tests and calculations, the amount of steam used by the various heating and evaporating units, the rates at which this steam is used and the variations in the rates of consumption. The amount of power to be produced is then calculated, and from these data a decision can be arrived at as to boiler pressure, whether steam is to be saturated or superheated and the type, kind and size of prime mover. An ample margin should be left between exhaust steam produced and exhaust steam consumed, to allow for the fluctuations in the production and consumption of exhaust.

In the final analysis it is to pay dividends that manufacturing plants exist. A sugar refinery melting 1,000 tons of sugar per day will consume 2,000 lb. of exhaust steam per ton of sugar melted where exhaust steam is used for all heating and all evaporating except for boiling the white sugars. For boiling the white sugars there will be required 1,800 lb. of steam per ton raw melted. Under these conditions the sweetwater is boiled in a triple-effect evaporator, the vapors from the evaporators are used to heat the water used in the refining process and the granulated sugar liquor is thickened up in a single-effect evaporator with exhaust steam to 68-69 deg. Brix. The white sugar is boiled with 40 to 90 lb. steam with coil pans in most refineries today.

Recently, it has been discovered that white sugar can be successfully boiled in calandria pans with 15-lb. steam. In due time the calandria pan will undoubtedly be used more extensively for boiling white sugars. This will increase the consumption of exhaust steam and permit the use of steam at existing low boiler pressure in engines exhausting at 15 lb. to the Calandria pans.

It was found that 596.4 lb. of steam is required per ton of raw sugar melted to heat the necessary water. In like manner the steam used on the various evaporating apparatus was computed, the quantity of water evaporated being figured from the Brix of the liquor entering and leaving the evaporators or vacuum pans, allowance being made for the specific heat of the liquor at the different densities.

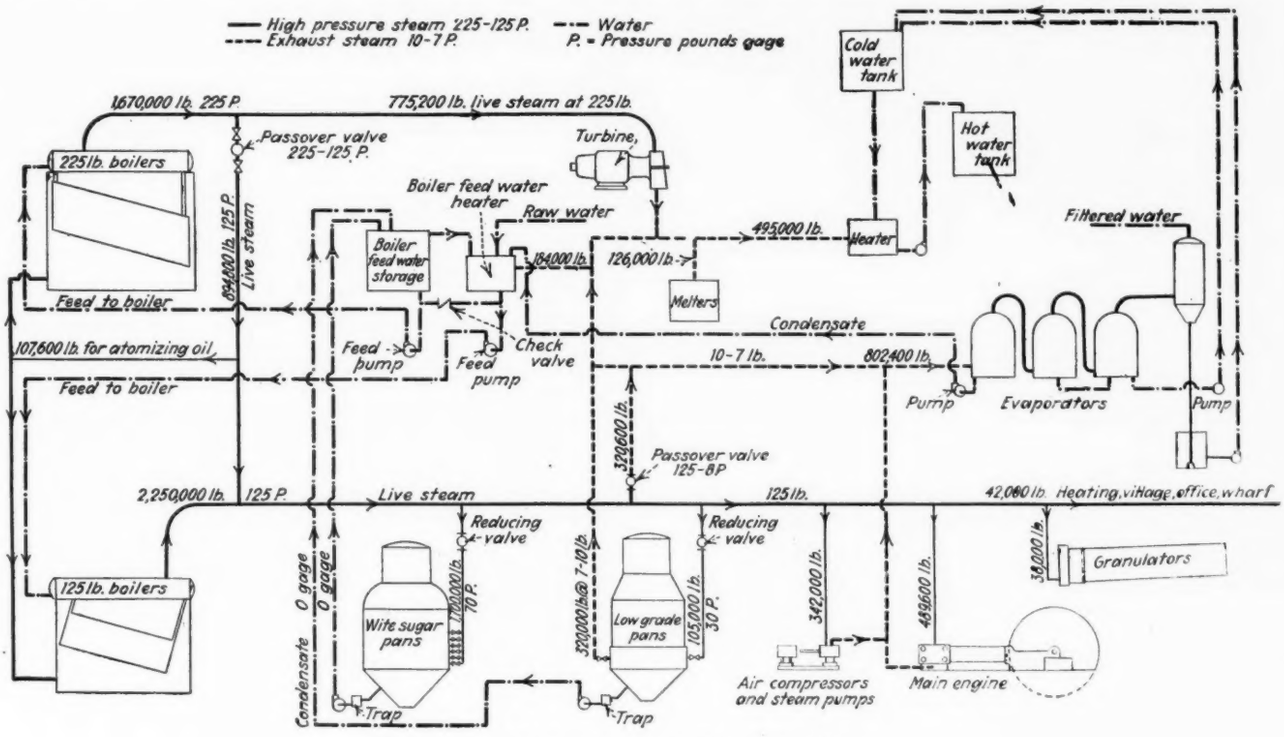


Fig. 3—The heat flow chart of the refinery

Having arrived at the amount of exhaust steam consumed, the next step was to find the amount of power produced and the exhaust steam resulting. At the Savannah refinery it was possible to arrive at these figures quite accurately. The amount of power purchased with maximum demand over quite a period of time was known.

The Corliss engine driving the mainline shafting and the 200-kw. generator were so piped that the exhaust could be condensed and the condensate weighed. Thus it was possible to get the water rate on the two main power units. The water rate of the air compressor was obtained from indicator diagrams, and that of the steam pumps from tests and estimates. From the survey made it was found that the power requirements were about 35 kw. per ton of raw sugar melted. Previously, it had been found that 2,600 lb. of exhaust steam was used per ton of sugar melted, or 74.3 lb. per kw.-hr. of power. Owing to the wide fluctuations in the demand for power

and the consumption of exhaust, a prime mover was chosen having a water rate of 36 lb. per kw.-hr., or about one-half the demand for exhaust over a 24-hour period. A turbine operating at 225 lb. initial and 10 lb. back pressure with a capacity of 1,250 kw. would meet the foregoing conditions. The size was determined upon to take care of the present power requirements and to provide some capacity for future increase in load.

The wear on the blades of the turbine when operating on saturated steam was not considered of enough importance to install superheaters, as turbines have operated over a period of years on saturated steam without any appreciable increase in steam consumption. The replacing of the blades on a Curtiss turbine is not more expensive than reboring the cylinders and overhauling an engine of the same capacity. In the choice of current either 220-volt direct current or 550-volt three-phase 60-cycle alternating current could have been selected, for part of the plant was operating on direct current and part on alternating. There is an objection to alternating-current induction-type motors on account of their low starting torque, resulting in the installation of underloaded motors when operating with increased generator capacity on account of low power factor.

A sugar refinery will need 2,000 lb. of exhaust steam per ton of sugar melted when exhaust steam is used for all heating and evaporation.

As against this the direct-current motor has a much higher first cost, a higher cost of wiring and a more expensive upkeep. It was decided that the alternating motor was much to be preferred. The low power factor from tests was found to be more fancied than real, the plant as now operating having a power factor considerably over 80 per cent.

In the design of the new plant it was decided to install a unit of sufficient capacity to take the load carried by the purchased power and that carried by the 200-kw. generator and to convert the entire plant to alternating current. The new unit was to have sufficient capacity to convert a large number of the steam-driven pumps to motor-driven and to provide some capacity for future expansion. It was decided to keep the main engine driving the lineshafting in operation for the time being, but the new plant was to be so laid out that an additional unit could be installed at some future date to replace the engine with motors if found advisable.

For the first unit of the new plant a straight back-pressure turbine-generator was chosen. This unit has a capacity of 1,250 kw. at 80 per cent power factor. The turbine is the Curtiss impulse type to operate at 3,600 r.p.m. and has a full-load water rate of 36 lb. per kw.-hr. with initial pressure at 225 lb. gage and with 10 lb. back pressure. The exciter is direct connected to the generator. Current is generated at 550-volt three-phase 60-cycle to permit the use of the alternating-current motors then in the plant. The power-plant building was so designed that three units of the size mentioned could be installed ultimately. This would permit replacing the present engine with motor drive, at which time the load would be carried by two units, with a third as a stand-by.

To supply steam for the turbine, there were available two water-tube boilers of 9,610 sq.ft. each. These boilers were installed some years ago to supply process steam to the plant and were designed to operate at 225 lb. gage. This pressure was decided upon so that when a new power plant was built, these boilers would be available for supplying steam for power purposes. Both boilers are operated at 225 lb. pressure, the excess steam being bled over into the 125-lb. main by means of a pass-over valve and the old boilers operate at 125 lb. When the second turbine is put in commission, additional boilers will be installed to take care of this unit and to replace some of the present low-pressure boilers which are about obsolete.

In building the new plant, the boiler feed-water system was redesigned. In the old system the boilers were fed by means of steam-driven pumps. The vacuum pans and evaporators had individual steam pumps to pump the condensate from these units into the boilers. Additional steam pumps were used to supply the boiler makeup water. This supply was taken from the refinery hot-water tank.

In the feed-water system as redesigned, the steam pumps taking the condensate from the evaporators and vacuum pans, were replaced with motor-driven centrifugal pumps. The condensate from the pans is returned to a storage tank of 5,000 gal. capacity, while the condensate from the evaporators is returned to an open-type heater. This heater also had a makeup water connection, this water amounting to about 25 per cent of the total boiler feed. The open-type heater has a steam connection to the exhaust-steam system which is maintained at about 7 to 10 lb. gage. Thus all the boiler-feed water is heated to about 235 deg. F. As the condensate from the vacuum pans is returned at a pressure above 10 lb., a flash-over line is provided from the storage tank into the feed-water heater allowing the steam from this tank to flash over into the feed-water heater and to help heat the feed makeup water. By this method all the flash from the condensate is conserved.

The exhaust steam needed for processing is equal to 74.3 lb. per kw.-hr. of power demand, and 35 kw. of energy is used per ton of sugar.

For supplying feed water to the low-pressure boilers, a two-stage direct-connected centrifugal pump is provided, with two old steam-driven reciprocating pumps as stand-by. The high-pressure boilers are supplied by means of a five-stage direct-connected motor-driven centrifugal pump and a three-stage turbine-driven stand-by pump. The motor-driven pumps operate at 1,750 r.p.m., while the turbine-driven pump runs at 2,750 r.p.m. The low-pressure boiler-feed pumps take their suction from the feed-water heater and the high-pressure boiler-feed pumps take their suction from the storage tank. The heater and storage tank are interconnected so that if the water gets low in the storage tank it will be supplied from the heater. A check valve prevents the water from the storage from flowing into the heater except through the flash-over line at the top of the tank. With this

arrangement the high-pressure boilers, which supply the turbine with steam, are fed with pure condensate and the makeup water goes to the low-pressure boilers. The vacuum pans connected to the storage tank supply all the feed water for these boilers.

The switchboard is of the remote mechanical-control type, with panels for the present generator and exciter, spare panels for two future generators and a panel for the 35-kw. engine-driven generator which is used to charge storage batteries. This generator is hooked up so that it can act as a spare exciter should the direct-connected exciter become inoperative. Four power feed panels are provided with two spare panels for future expansion. Two panels are provided for street and village lighting and one refinery lighting panel at 550 volts and one at 220 volts. Four power feeders, each consisting of three 500,000-cm. varnished cambric cables in 3-in. conduits, supply the mill with power.

There are installed in the refinery a total of 120 motors rating a little over 2,000 hp., the largest unit being 250 hp. The load on the generator varies with the plant in operation from 550 to 1,100 kw.; the lighting load is about 60 kw. in the daytime and 100 kw. at night. The power factor varies from 82 to 86 per cent, but by shifting several motors that are underloaded, this will be improved.

The high-pressure steam piping is all extra-heavy, with steel flanges and Van Stone square-edge joints, the fittings being extra-heavy cast iron. The 10-in. steam line extending into the turbine room is large enough to supply two 1,250-kw. turbines and is protected by a steam separator. The 18 in. turbine exhaust piping is standard wrought iron with standard cast-iron fittings. A relief to atmosphere is provided so that it is impossible to build up high pressure on the exhaust side of turbine. The feed-water piping is all extra-heavy. A Venturi meter measures the water to the low-pressure boilers. A flow meter measures the water to the high-pressure boilers.

All boilers are oil fired. The control is automatic and the steam pressure on all boilers maintained through a range of about five pounds.

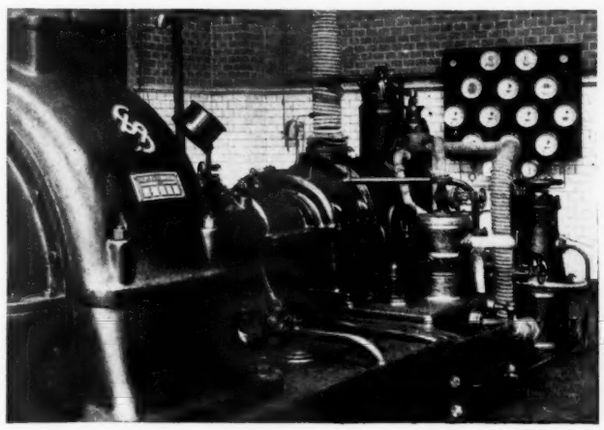
The first material for this plant was ordered in the latter part of July, 1926. Ground was broken for the foundations in August, and the plant was carrying full load by Jan. 15, 1927. All design and construction were done by the company's own force.

The conclusions arrived at from the steam and power survey of the plant have worked out about right, in that the greater part of the time there is a steam balance or a deficiency of exhaust steam available. This deficiency is made up by cutting over live steam into the low-pressure mains through a reducing valve. Occasionally, the relief valve opens and exhaust blows to the roof. This, however, occurs only at times of abnormal operation and the loss is almost negligible.

A Swiss High-Pressure Turbine

THE illustration shows the nine-stage turbine built by Escher Wyss & Company, of Zurich, Switzerland, to operate with 1,422-lb. steam and exhaust against a back pressure of 171 lb.

High-pressure steam is supplied by a Benson boiler installed at the works of Siemen-Schukert & Company, Germany. The steam is reheated in passing through the superheater of a low-pressure boiler. The superheating surface is too small to obtain an increase in steam temperature of more than 27 to 36 deg. F., but structural difficulties made it impossible to install a larger superheater in the old boiler. The reheated steam at 171 lb. is delivered to an old condensing turbine. The turbine speed of 10,000 r.p.m. is reduced by a reduction gear to 3,000 for driving a direct-current generator.



The 10,000-r.p.m. 1,422-lb. turbine

WHAT DO YOU KNOW?

By L. H. Morrison

The answers are on page 1114

Ques. 1—Can one obtain a double-acting automatic stop valve for a boiler, so that the valve will close in case a tube splits and also close if the steam main breaks?

Ques. 2—A fan operating at 50 r.p.m. requires 20 hp.; what will be the approximate horsepower needed if the speed is raised to 100 r.p.m.?

Ques. 3—Does superheating steam give a greater efficiency increase in a reciprocating engine or in a steam turbine?

Ques. 4—Why are radiators generally placed under windows?

Ques. 5—Can anthracite be burned on a traveling grate if there is no ignition arch?

Ques. 6—If a shelf is placed over the radiator, is there any reduction in the heating effect of the radiator?

Ques. 7—Suppose a mercury-in-glass thermometer which is at a room temperature of 60 deg. F. is thrust into a thermometer well in a steam pipe; will the mercury rise to the correct steam temperature immediately, or will it read lower or higher than the true temperature.

Ques. 8—Suppose you had a disk-type flywheel consisting of a forged plate 2 in. thick with a 4-in. rim and a 6-in. hub, to be put on a shaft. Would you bore the disk bore under size and heat it to permit it to be slipped on the shaft?

Ques. 9—If a plate of glass is held flat and heated on its lower side, it will bend, but which way?

Ques. 10—Does a conversation between two engineers cause a temperature change, even when the subject is not controversial?

ANALYSIS OF SOLID FUELS*

PART I

Sampling, Proximate and Ultimate Analyses

By A. A. POTTER and H. L. SOLBERG

Dean of Engineering, Purdue University — *Ass't Prof. of Mechanical Engineering, Purdue University*

This is the third of a series of articles dealing with the availability of different fuels, their classification, selection, properties and utilization.—*Editor*

CARBON and hydrogen are the principal combustible constituents of fuels; that is, those elements that will unite chemically with oxygen, thereby producing heat. Part of the sulphur present in fuels may be combustible, but it is generally classed as an undesirable impurity. Certain other elements or compounds are present which are inert, thereby diluting the combustible matter and reducing the heating value per pound. These include nitrogen, moisture, and ash or mineral impurities.

The elements of which fuel is composed are combined in many complex compounds, so that the problem of determining the comparative value of several fuels from their analyses is difficult. The final test of the value of a fuel is in the burning of it, although much can be determined about its characteristics from an analysis. Coal analyses are reported as "proximate" and "ultimate." The percentages by weight of fixed carbon, volatile matter, moisture and ash are reported in a proximate analysis. The ultimate analysis consists of a determination of the percentage by weight of each of the important chemical elements in the fuel. A calorimetric determination of the heating value of the fuel is generally included in each analysis.

For accurate results the sample must contain all the original constituents of the coal in the same proportions as they occur in the car or pile from which the sample is obtained. Coal is not a homogeneous mass, as the fines generally contain a larger percentage of impurities than the lumps, and slate or other extraneous material may be present in pieces of considerable size. A sample may be collected by means of a shovel or sampling ladle, some coal being taken from all parts of the pile, car or conveyor in a regular and systematic manner. The weight of the gross sample so collected depends on the size of the largest lumps in the coal sampled and should not be less than indicated in Table I.

TABLE I—RELATION BETWEEN SIZE OF COAL AND WEIGHT OF SAMPLES

Largest Size of Coal and Impurities before Division	Weight of Sample To Be Divided
1-in.	1,000 lb. or more
¾-in.	500 lb. or more
½-in.	250 lb. or more
⅜-in.	125 lb. or more
¼-in.	60 lb. or more
⅛-in. or 4-mesh screen	30 lb. or more

This gross sample should be reduced by crushing, mixing and quartering to two 5-lb. samples, which are placed in airtight containers. One may be sent to the laboratory for analysis and the other kept as a reserve. The gross sample should be reduced as quickly as possible to prevent loss of moisture by the coal.

PROXIMATE ANALYSIS

The moisture reported in a proximate analysis of fuel is the percentage loss of weight when a sample of coal that will pass a 20-mesh sieve is maintained at a constant temperature of 105 deg. C. (221 deg. F.) for a period of from one to one and a half hours. It is possible that some

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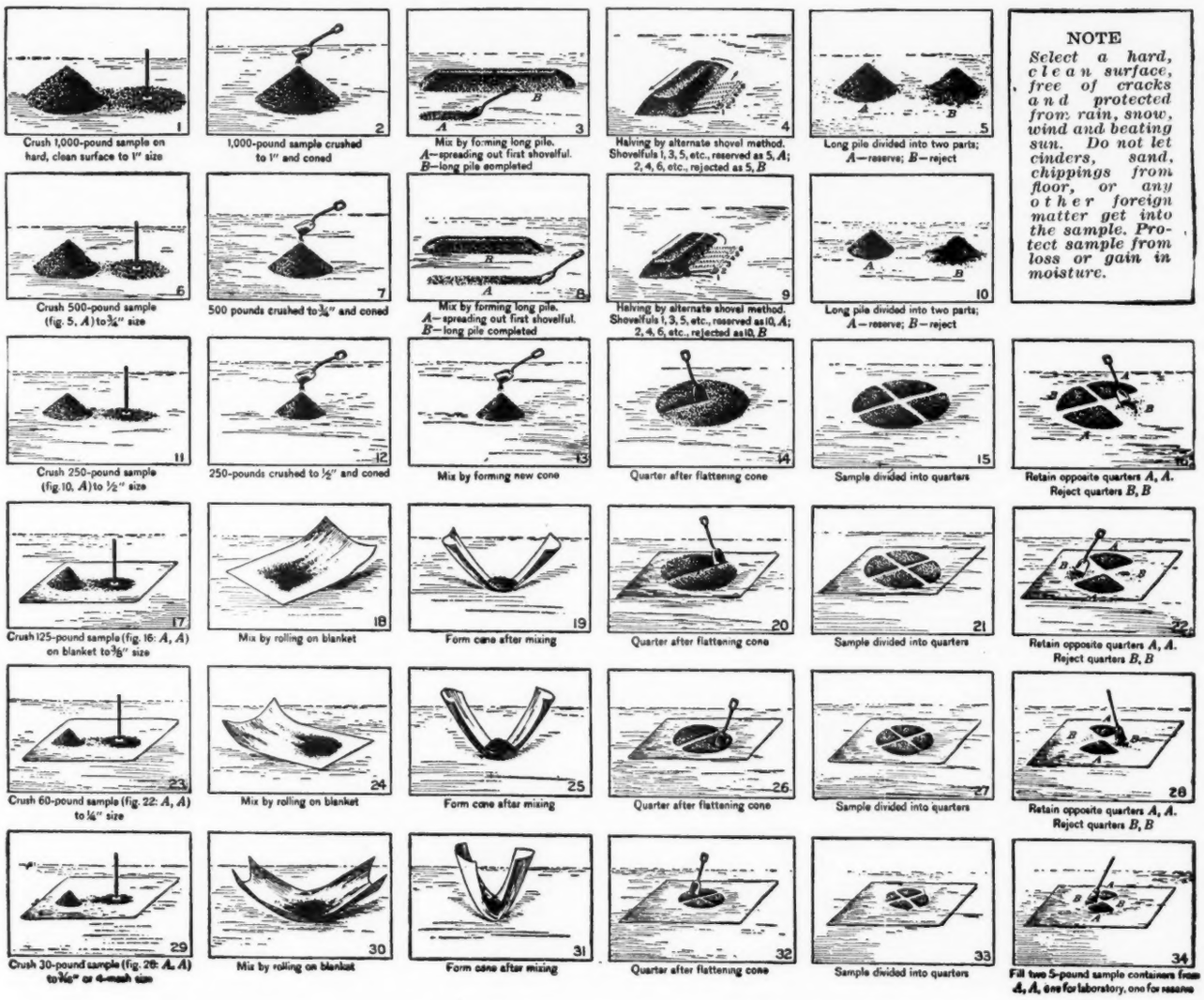
of the lighter hydrocarbon gases may be expelled at this temperature and some moisture remain after heating.

Volatile matter is arbitrarily defined as the percentage loss of weight minus moisture when a sample of coal that will pass a 60-mesh sieve, is heated for seven minutes at a temperature of 950 deg. C. (1,742 deg. F.) in a crucible equipped with a loose-fitting cover that will prevent oxygen from coming into contact with the sample. The volatile matter so determined does not represent any particular chemical compound in the coal, and the result of volatile matter. It is composed of carbon, some oxygen, nitrogen, etc., and in some anthracite coals may even exceed the total carbon in the coal, due to the presence of these other substances.

The sum of the volatile matter and fixed carbon is commonly referred to as the "combustible" in the coal, although a considerable portion of this "combustible" is inert material.

The items reported in an ultimate analysis are hydrogen, carbon, nitrogen, sulphur, oxygen and ash. The


NOTE
Select a hard, clean surface, free of cracks and protected from rain, snow, wind and beating sun. Do not let cinders, sand, chippings from floor, or any other foreign matter get into the sample. Protect sample from loss or gain in moisture.
Crush 1,000-pound sample on hard, clean surface to 1" size
1,000-pound sample crushed to 1" and coned
Mix by forming long pile. A—spreading out first shovelful. B—long pile completed
Halving by alternate shovel method. Shovelfuls 1, 3, 5, etc., reserved as 5, A; 2, 4, 6, etc., rejected as 5, B
Long pile divided into two parts; A—reserve; B—reject
Crush 500-pound sample (fig. 5, A) to ¾" size
500 pounds crushed to ¾" and coned
Mix by forming long pile. A—spreading out first shovelful. B—long pile completed
Halving by alternate shovel method. Shovelfuls 1, 3, 5, etc., reserved as 10, A; 2, 4, 6, etc., rejected as 10, B
Long pile divided into two parts; A—reserve; B—reject
Crush 250-pound sample (fig. 10, A) to ½" size
250-pounds crushed to ½" and coned
Mix by forming new cone
Quarter after flattening cone
Sample divided into quarters
Retain opposite quarters A, A. Reject quarters B, B
Crush 125-pound sample (fig. 16: A, A) on blanket to ⅜" size
Mix by rolling on blanket
Form cone after mixing
Quarter after flattening cone
Sample divided into quarters
Retain opposite quarters A, A. Reject quarters B, B
Crush 60-pound sample (fig. 22: A, A) to ¼" size
Mix by rolling on blanket
Form cone after mixing
Quarter after flattening cone
Sample divided into quarters
Retain opposite quarters A, A. Reject quarters B, B
Crush 30-pound sample (fig. 28: A, A) to 3/16" or 4-mesh size
Mix by rolling on blanket
Form cone after mixing
Quarter after flattening cone
Sample divided into quarters
Fill two 5-pound sample containers from A, A, one for laboratory, one for reserve

Method of Preparing a Sample of Coal by Hand

The necessary tools are a shovel, tamper, blanket measuring about 6 by 8 feet, broom and rake. The coal is raked while being crushed, so that all lumps will be crushed. Floor or blanket is swept clean of discarded coal each time after sample is halved or quartered.—*From Bureau of Mines Bulletin* 116.

the determination depends upon the temperature to which the sample is heated and the rate of heating. The volatile matter is sometimes called "volatile combustible," although with some coals over one-third of it may be inert oxygen and nitrogen compounds.

Ash is the incombustible residue obtained by heating a sample of coal to 750 deg. C. (1,382 deg. F.) in the presence of oxygen until a constant minimum weight is obtained.

The fixed carbon is determined by subtracting from 100 the sum of the percentages of moisture, ash and hydrogen, carbon, nitrogen and sulphur are determined by the methods of organic quantitative analysis. The ash is found by the method outlined under "Proximate Analysis." The oxygen is obtained by subtracting from 100 the sum of the percentages of the other constituents of the coal. Consequently, the error in the oxygen determination is the algebraic sum of all errors made in the analysis. All moisture in the coal appears in the analysis as hydrogen and oxygen.

The performance of an accurate ultimate analysis requires the services of a chemist and involves considerable

special equipment. A proximate analysis requires only a good chemical balance and a few pieces of inexpensive apparatus. Since the proximate analysis furnishes sufficient information for the determination of the commercially important properties of coal, it is the analysis that is ordinarily made.

The analysis of a coal may be reported on several different bases, the most important of which are as follows:

1. *Fuel as fired* or fuel as received.
2. *Dry fuel* or fuel moisture free.
3. *Combustible* or fuel, moisture and ash free.

The terms in italics are used in the A.S.M.E. Boiler Test Code, while the second set of terms is employed in the publications of the United States Geological Survey and the Bureau of Mines. In the third classification the term "combustible" is a misnomer, since fuel that is moisture and ash free may contain a large percentage of inert or incombustible material. For the comparison of fuels an analysis on the moisture-free basis is generally preferred, since the moisture content of fuels depends upon the weather conditions to which the fuel has been exposed between the time it is mined and the time it is sampled. The power-plant operator prefers the analysis of coal "as received" or "as fired," because he is interested in the results obtained from the coal as it was fired.

Conversion Methods

The method of converting a proximate analysis from one basis to another is shown by Example 1.

EXAMPLE 1

	Column A As Received Per Cent	Column B Moisture Free, Per Cent	Column C Moisture and Ash Free, Per Cent
Fixed carbon	53.83	59.02	64.33
Volatile matter	29.85	32.73	35.67
Ash	7.52	8.25	.....
Moisture	8.80	.....	.....
	100.00	100.00	100.00

Column B is obtained by dividing the percentages of fixed carbon, volatile matter and ash in column A by (1.00 — moisture), or 0.912 in this case. Column C is obtained by dividing the percentages of fixed carbon and volatile matter in column A by [1.00 — (moisture + ash)], or in this case by 0.8368.

The method of converting an ultimate analysis from one basis to another may be illustrated by Example 2, using the analysis of the same coal.

EXAMPLE 2

	Column A As Received Laboratory Analysis, Per Cent	Column B As Received, Per Cent	Column C Moisture Free, Per Cent	Column D Moisture and Ash Free, Per Cent
Carbon	68.70	68.70	75.33	82.11
Hydrogen	5.08	4.10	4.49	4.89
Oxygen	16.24	8.42	9.23	10.06
Nitrogen	1.33	1.33	1.46	1.59
Sulphur	1.13	1.13	1.24	1.35
Ash	7.52	7.52	8.25	.....
Moisture from proximate analysis	.....	8.80	.....	.....
	100.00	100.00	100.00	100.00

The hydrogen and oxygen reported in the laboratory analysis, column A, includes that in the free moisture (the moisture determined in the proximate analysis). From the proximate analysis the free moisture is found to be 8.8 per cent. Since one-ninth of this moisture is hydrogen and eight-ninths is oxygen, then column B is obtained as follows:

1. Insert in column B the free moisture from the proximate analysis.

2. Subtract from the total hydrogen (5.08 per cent) the hydrogen in the moisture ($\frac{1}{9} \times 8.80$ per cent), leaving 4.10 per cent hydrogen.

3. Subtract from the total oxygen (16.24 per cent) the oxygen in the moisture ($\frac{8}{9} \times 8.8$ per cent), leaving 8.42 per cent oxygen.

4. The percentages of the other constituents will remain unchanged.

The analysis in column B can be reduced to a "moisture free" basis, column C, by dividing each item in column B by (1.00 — moisture) or 0.912, in the same manner as was done with the proximate analysis. Similarly, column D is obtained by dividing each item in column B by [1.00 — (moisture + ash)], or 0.8368.

It is often convenient to distinguish between "free" and "combined" moisture in coal. It is assumed that all the oxygen in the coal is combined with hydrogen in the form of water. Since water is eight-ninths oxygen (by weight), then the "total moisture" in coal is nine-eighths times the total oxygen. The "combined" moisture is the "total" moisture less the "free" moisture. In the preceding example the total moisture is $\frac{9}{8} \times 16.24$ (total oxygen), or 18.27 per cent. The "combined" moisture is 18.27 — 8.8 (free moisture), or 9.47 per cent.

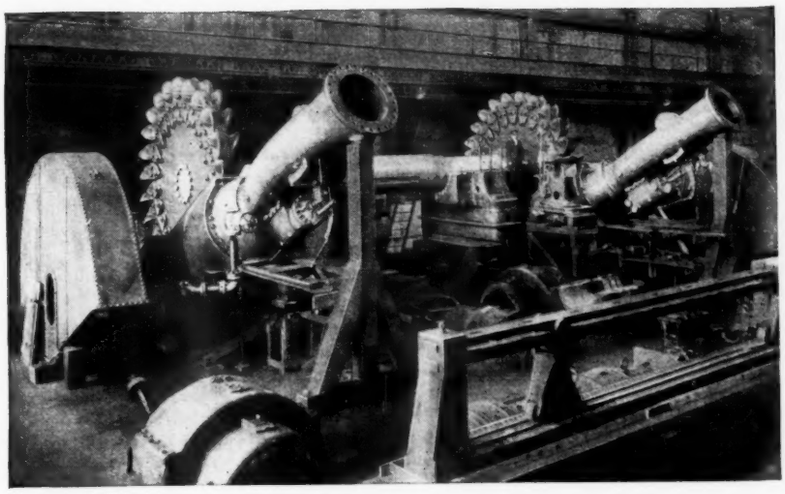
Since it is assumed that all the oxygen is combined with hydrogen to form water and water is composed of one part of hydrogen to eight parts of oxygen, then the hydrogen combined with oxygen is total oxygen ÷ 8. The remaining hydrogen [total hydrogen — (total oxygen ÷ 8)] is called the "available" hydrogen. It is the hydrogen in the fuel which is free to unite with oxygen during combustion and liberate heat.

Hydro Plant on Stilts

THE real engineer attacks new problems with an open mind. He starts by considering the results to be obtained and moves out step by step to the completed design, which may be a radical departure from established practice. A new hydro-electric plant on the Kentucky River is a good example. High in the air it stands. mounted on three piers. Vertical shafts carry the drive up through the piers from wheels to generators. The roof of the turbine pit acts as part of the dam spillway. On top of the generator room is perched a gantry crane. All in all a good example of the infinite adaptability of engineering. L. F. Harza will tell the story in the June 26 issue.

Largest Impulse Waterwheels

rated at 60,000 hp. when operating under a 2,300-ft. head.



The two wheels with their shaft and generator rotor weigh about 620,000 pounds

AT THE present time two 56,000-hp. double overhung impulse wheel units are being installed at the Big Creek 2-A plant of the Southern California Edison Company, Los Angeles. These units hold the world record as to capacity and to some extent also as to physical size. They will operate under a maximum net head of 2,300 ft. and will develop 60,000 hp. each at 250 revolutions per minute.

One of these wheels was built by the Allis-Chalmers Manufacturing Company and is shown in the figures. The shaft is about 35 ft. long and weighs nearly 100,000 lb., having a diameter of about 40 in. where it carries the generator rotor weighing about 400,000 lb. The two bearings are probably the largest ring-oiling type bearings in the world. They have ball-and-socket seats, babbitted shells, 32-in. bore and are seven feet long. The next largest size impulse waterwheel bearings are in use at the Caribou plant of the Great Western Power Company, of San Francisco, and have a 24¾-in. bore.

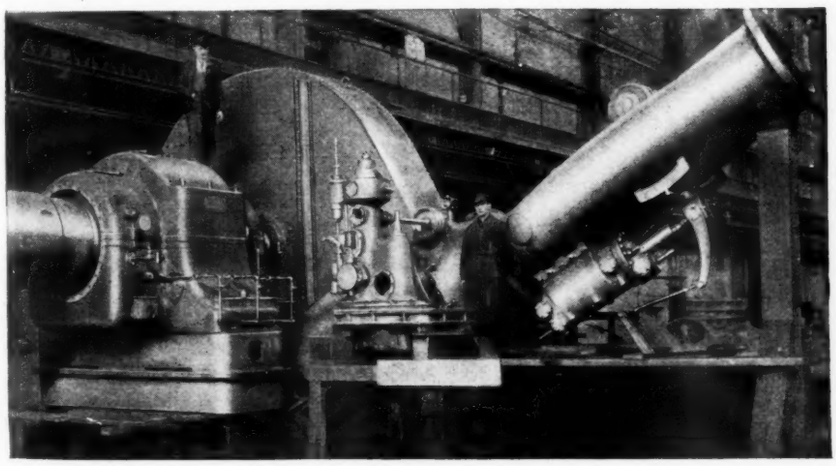
Overhung on each shaft end is a steel wheel disk with cast-steel buckets, weighing about 50,000 lb. and receiving an impact force of about 90,000 lb. at full load from a water jet about 8½ in. in diameter, having a velocity of about 255 miles an hour.

With regard to size of jets, the Caribou units still hold the world record, with a diameter of eleven inches, but will soon be exceeded by the new unit under construction for the San Francisquite No. 1 plant of the Bureau of Power and Light, Los Angeles. This unit will have two jets each fourteen inches in diameter.

It will be noted from the pictures that the water is brought through the nozzle pipes to the wheels in a direction that is the continuation of the pipe-line axis following the grade to the power house. This is done to eliminate the hydraulic losses caused by bends. Each one per cent loss of efficiency means a power loss of 600 hp., which in itself represents a fair-sized hydro-electric generating unit.

Below is a close-up view of the right-hand wheel side of this unit, showing the bearing, governor actuator, wheel housing and the diamond-shaped nozzle pipe with an inlet diameter of 34 in. The servo-motor actuating the needle is attached to the under side of the nozzle pipe, as can be seen from the figure at the bottom of this page.

In the field the generator rotor will be mounted in the center of the rotor shaft, and the total weight of the complete rotating parts will then be about 620,000 lb. To this load must be added the impact force of the two jets, which, under full-load operation, increases the total weight to be carried by the two bearings to about 700,000 pounds.



One of the wheels with its governor, nozzle pipe and regulating cylinder completely assembled in the shop. The buckets on the wheel receive an impact force of 90,000 lb. at full load from a jet about 8½ in. in diameter having a velocity of 255 miles an hour.

How to Overcome Troubles Found in
One-Pipe Heating Systems

By C. P. Benneche

A ONE-PIPE steam heating system, the system in which the condensation flows back from the radiator through the same pipe that carries the steam to the radiator, is subject to various troubles that are familiar to the engineer in charge about in proportion to the experience he has in operating such a system, for he learns to overcome these troubles only by experience, since they are not ordinarily regarded as of sufficient importance or difficulty to be treated in print. It is my purpose to enumerate the more common of these troubles and to offer simple remedies that have proved successful in practice.

Working Back from the Radiator to the Boiler

Assuming that the heating system as a whole is correctly installed, the troubles encountered are usually local, being confined to one or a few radiators or to the radiators on one main or riser. Therefore we will reverse the more obvious procedure of starting at the boiler and working out through the mains and risers toward the radiator and, instead, will start our investigation at the radiator and work back toward the boiler.

Let us consider first a case where one radiator is not heating properly. Is the valve open? If not, open it. This may seem ridiculous, but it is the most common

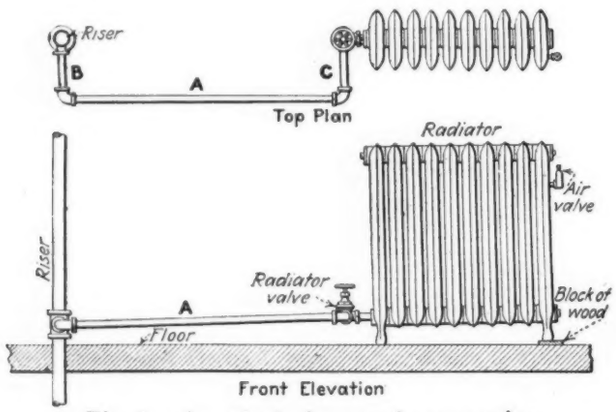


Fig. 1—A method of correctly connecting radiator and riser

trouble encountered. Do only a few sections heat up? Look to the air valve. If it is an air valve of the adjustable type, open it a bit with a screwdriver or, better still, take it off and throw it away. This is not ridiculous either. Why should an air valve be adjustable? It should be open to discharge cold air and should close when in contact with steam. Therefore get an air valve that will always do this and will not get out of order, an air valve that is properly adjusted by the manufacturer and has no adjusting screw for somebody else to tamper with.

If the radiator valve is open and the air valve working properly and the radiator still does not heat up, the trouble may be due to condensation collecting in the radiator. This is sometimes indicated by water flowing out of the air valve. To remedy this trouble, first lift up the end of the radiator away from the radiator valve and place a block of wood under the legs so the radiator

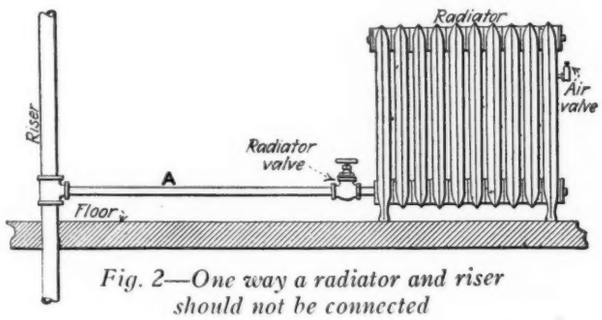


Fig. 2—One way a radiator and riser should not be connected

pitches toward the valve, as shown in Fig. 1. If this does not cause the radiator to heat up, the trouble is not in the radiator but in the piping.

Pipe from Riser to Radiator Should Have Plenty of Pitch

The pipe from the riser to the radiator *A*, Fig. 1, should have plenty of pitch toward the riser. This is all important. In order to secure this pitch, it is necessary to install pipe *A* with an elbow at each end and connect it to the tee on the riser by means of a short nipple *B* and to the radiator valve by means of a short nipple *C*, as shown in top view. These two nipples *B* and *C* then serve as swing joints to permit of pitching the radiator and pipe *A* as much as necessary to secure good circulation. The arrangement shown in Fig. 2, where pipe *A* is screwed directly into the tee on the riser and into the radiator valve, is incorrect and should never be used, as the radiator cannot be properly pitched without springing pipe *A*.

An installation such as that shown in Fig. 1 rarely gives trouble, but when one tee on the riser serves two or more radiators, trouble often arises. The correct way to arrange the piping in this case is shown in Fig. 3. Never install two or more radiators as shown in Fig. 4, with *A* and *B* leading out of a tee in opposite directions, as one then bucks the other and neither one gets sufficient steam although there may be plenty of pressure and the radiators may not be far from the riser. If *A*

is raised to pitch properly then, obviously, *B* will be lowered and consequently trapped. The installation shown in Fig. 3 provides a "swing joint" to through nipples *G, H, J* and *K*. These permit the pipes *A, B* and *C* to be pitched at any desired angle. Radiators may thus be placed at a considerable distance from the riser and still give perfect satisfaction. To secure this pitch without raising the radiators too high above the floor, it is often advisable to place the tee on the riser below the floor and run the pipes *A* and *B* right and left from it, coming up through the floor directly under where the radiator valve is to be placed.

An installation such as this may give perfect satisfaction in one location, but a similar arrangement in another location may not. For instance, the radiator at left attached to *A* may be working properly, but the radiator at right attached to *B* may fill with water, as may the radiator attached to *C*. The pitch of pipe *B* and *C* may may be the same as the pitch of a similar pipe attached to this riser on another floor, which does not give trouble. In a case such as this the trouble may be remedied by swinging *B* up a bit, shortening *E* and *F* and thus giving *B* more pitch toward the riser. This is an illustration of the kind of trouble that may appear in operation and was not evident in the design of the system. The only solution appears to be to deal with each trouble on its own merits as it arises and take the obvious step to remedy the trouble even though that step may not seem to be necessary. A local trouble such as this should be dealt with locally. It may occur to the engineer in charge to free the radiators on a riser of water by running a drip line or "bleeder" from the bottom of the riser into the return main. This is the proper thing to do if there is trouble on the whole riser, but the idea should not be entertained in a case like the one cited

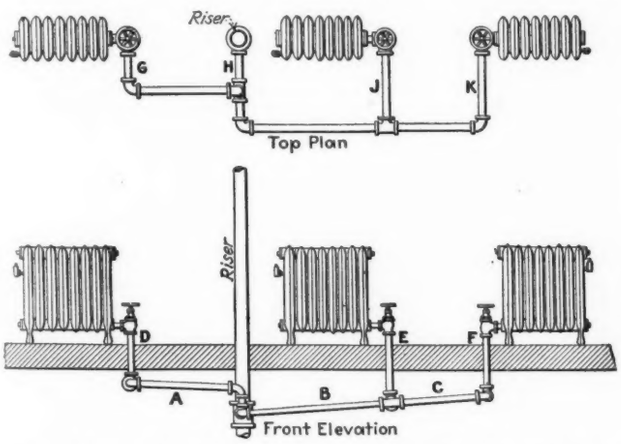


Fig. 3—A correct method of connected two or more radiators to the same riser outlet

because, although the radiators on pipe *B* were giving trouble, the radiators on pipe *A* were not. A trouble like this is in *B* and not in the riser.

It is often proposed to keep a radiator free from water by draining the condensation from the air valve through a drip line running from the air valve on the radiator to the return main. But a remedy such as this is at best a makeshift and an apology for the real solution. It may be necessary in certain unusual cases, but it practically changes the one-pipe to a two-pipe system, the drip line from the air valve serving as a return pipe. In a one-pipe system the one pipe should carry off the condensation and will carry it off if the pipe is large enough and is not trapped anywhere. Thus the point at which the pipe is trapped should be located and the necessary changes made so that it will drain. This rule applies

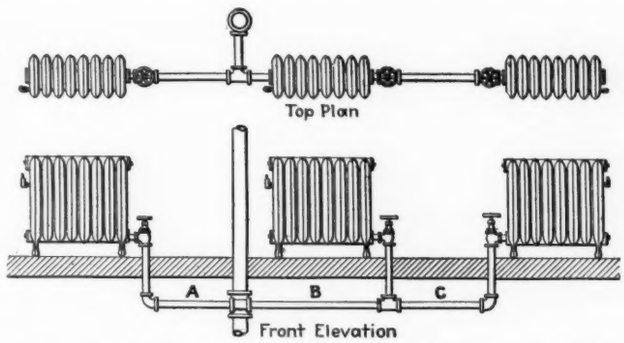


Fig. 4—A method of connecting radiators that will give trouble

to steam and return mains, where the trouble is general, as well as to individual radiators and riser branches where the trouble is local.

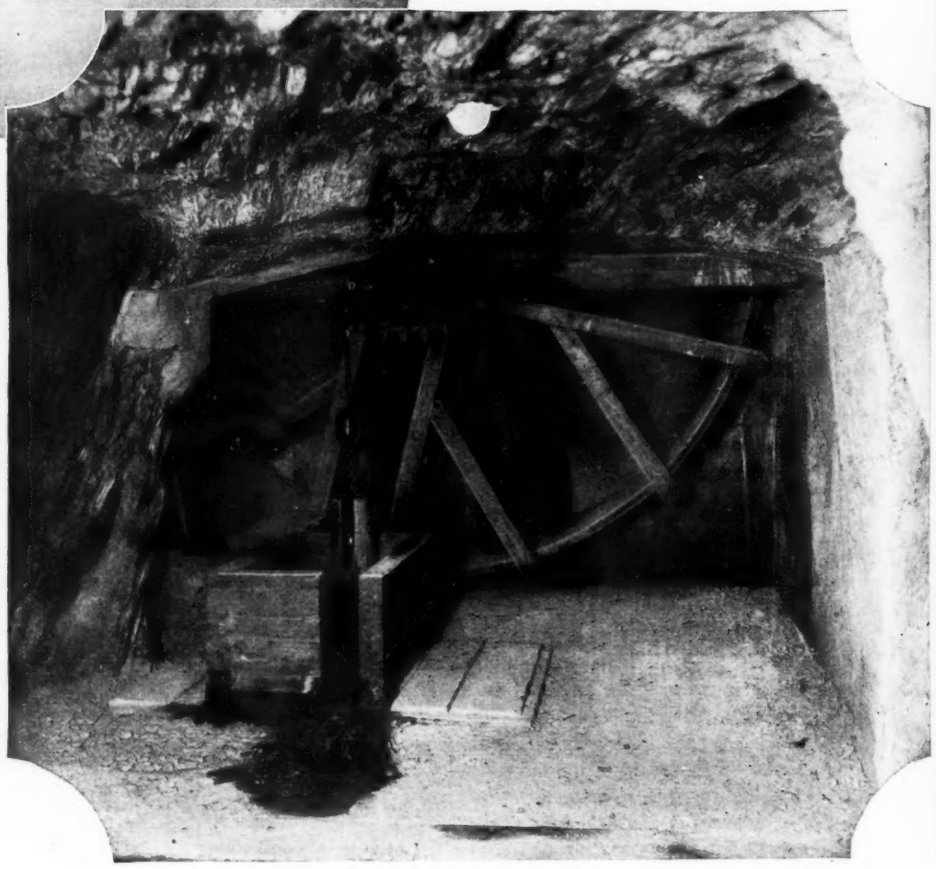
What the Scholar Learned of Combustion Years Ago

Combustion may be defined to be a process by which certain substances decompose oxygen gas, absorb its base and suffer its caloric to escape in the state of sensible heat. The agency of oxygen in combustion is attributable to its affinity for combustible bodies. The combustible having a greater affinity to oxygen than oxygen has to caloric, the oxygen gas is decomposed, and its oxygen combines with the ignited body, while its caloric, becoming free, is diffused among the surrounding bodies. Whenever we burn a combustible body, a continued stream of atmospheric air flows toward the fire place, to occupy the vacancy left by the air that has undergone decomposition, and which, in its turn, becomes decomposed also. Hence a supply of caloric is furnished without intermission, till the whole of the combustible is saturated with oxygen.

Quoted from "The Literary and Scientific Class Book," by Rev. John Platts, published in Doncaster, England, 1821.

MUNICH *records Industry's*

Left—View of the steam-pumps division hall. Note pictorial story of power progress over entrance, and exceptional abundance of light

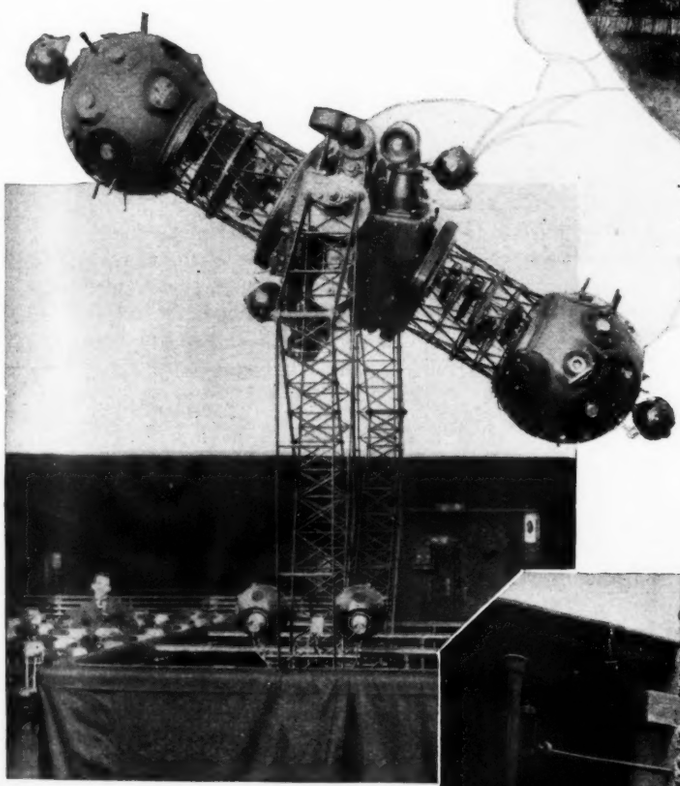


Right—Early tread-mill pump used in coal mines. Such pumps were worked by convicts. This is a full working model

MUSEUM

Early Days

Above—A single widespread building, perpetuating models and full sized operating equipment, the Deutsches Museum invites study of machinery, processes, methods and structures in all branches of engineering



Above—Device for Projecting the Heavens—this intricate "planetarium" is an improvement on the Munich machine and has been installed in seven large German cities

Right—Watt engine and original Watt wagon-top boiler dating from 1810—a full size specimen with sun-and-planet gearing

An Answer to the Question

Is the High-Speed Two-Cycle Diesel Possible?

By P. H. Schweitzer

Assistant Professor Research, Pennsylvania State College

THE opinion is generally held that the four-stroke cycle is more adaptable for high speed than the two-stroke cycle. Accordingly, the majority of high-speed engines are built to operate on the former principle.

With carburetor engines there is another good reason for the use of the four-stroke cycle. In the conventional two-stroke-cycle gasoline engine the scavenging is done with an air-gasoline mixture which involves a fuel waste that can hardly be avoided. For fuel-injection engines this objection does not exist, because the scavenging is done with pure air. Aiming for high speed, preference usually is given to the cycle which insures the higher volumetric efficiencies.

It has been stated that the two-stroke cycle is less suitable for high speed than the four-stroke cycle because less time is available for charging and exhaust, therefore the quality of scavenging will decrease with the increase of speed much faster than with the four-stroke cycle. Dr. O. Holm made a remarkable study of the mechanics of scavenging and came to very interesting conclusions.

He endeavored to determine how the engine speed affects the volumetric efficiencies of properly designed engines of both the two-stroke and four-stroke cycles and what are the maximum speeds attainable.

In a four-stroke-cycle engine it is difficult to make the intake valve area larger than one-tenth the piston area; consequently the air velocity through the intake valve will be not less than about seventeen times the mean piston speed. This will permit only a partial filling of the cylinder. The relation between piston speed and volumetric efficiency is shown by the curve A_1 in Fig. 1, when the valve area is one-tenth that of the piston. Curve B_1 shows the products $c_m n_v$, which are proportional to the engine output plotted against piston speed. From this curve it is clear that it is useless to increase the piston speed beyond 2,750 ft. per min., because such an increase will not result in an increase of engine output. For comparison, the broken lines show what the corresponding curves would be for a free valve area equal to one-fifth of the piston area. The effect of the valve resistance can be clearly seen.

Ordinarily, the valve area is not larger than one-tenth the piston area, and a piston speed of 2,750 ft. per min. corresponds to the maximum engine output. It will be noticed that the limitation affects only the piston speed and not the number of revolutions per minute. One may have any r.p.m. by making the stroke short enough. A short stroke for a given cylinder volume means a small stroke-bore ratio and a flat combustion space, which is incompatible with good combustion. For this reason the stroke should not be less than 1.5 times the bore for high-compression engines. Hence, the limiting r.p.m. for a four-stroke-cycle engine with 1.5 stroke-bore ratio and $\frac{1}{10}$ valve area are:

Dia. in.	2	5	10	20	30	40	50
R.p.m.	5,500	2,200	1,100	550	366	275	220

These represent the highest engine speeds we can hope to attain with the ordinary engine.

The problem with the two-stroke-cycle engine is much more complicated, as there is a possibility of partly counteracting the effect of the high rotational speed by varying the port height and charging pressure.

Doctor Holm found that in a two-stroke-cycle engine neither the r.p.m. nor the piston speed is the determining factor, as it is for the four-stroke-cycle engine. Instead, a quantity called specific speed, $\frac{DN}{\mu}$, which is the product of the cylinder diameter in inches and the r.p.m., divided by the relative port width μ, determines the scavenging characteristics of an engine. The relative port width $\mu = \frac{b}{D}$ is the relation of the effective port width to the cylinder bore and is about 0.7, except in opposed-piston engines.

The preferable charging pressures for varying specific speeds according to Doctor Holm's calculations, which are too complicated to be reproduced here, are those shown on Fig. 2.

A scavenging pump efficiency of 0.8 was assumed in plotting the curve, but a different pump efficiency will give but slightly different results.

The ratios of the preferable port height to the piston stroke, $\frac{h}{s}$, are shown in Fig. 3 for varying specific speeds. It will be noticed that the optimum port height increases

rapidly with the specific speed, and at 20,000 it reaches 36 per cent of the stroke. This would be the case for an engine with 10-in. bore and 1,400 r.p.m. The best charging pressure for this case would be 6 lb. per square inch.

Even using these increased port dimensions and pressures, the volumetric efficiency will drop considerably for increased specific speeds as shown by Fig. 4. For the case mentioned it would be only 52 per cent.

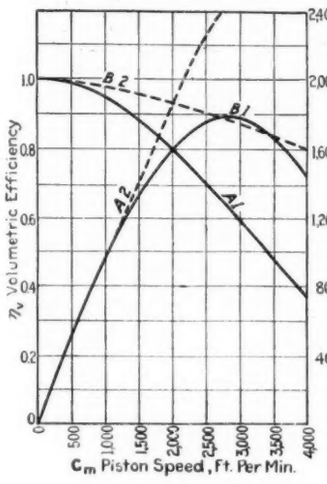


Fig. 1 — Volumetric efficiency of four-stroke-cycle engines

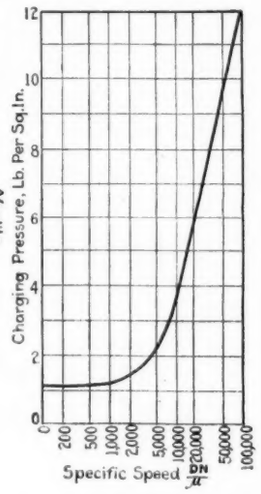


Fig. 2 — Preferable charging pressures for two-stroke-cycle

The other curve on the same figure represents the product $n_v \frac{DN}{\mu}$ The cylinder output can be increased so long as this curve rises. This point is reached at a 31,500 specific speed. For a 10-in. bore engine this would correspond to 2,200 r.p.m., but for 2-in. bore the maximum speed is 11,000 r.p.m. For various cylinder bores the corresponding maximum rotating speeds are as follows:

Dia., in.	2	5	10	20	30	40	50
R.p.m.	11,000	4,400	2,200	1,100	740	550	440

The results of the investigation for the two- and the four-stroke-cycle principles can be compared if only we make assumptions regarding the stroke-bore ratio. We have seen that with the four-stroke-cycle short stroke is favorable to high speed. With the two-stroke cycle, on the other hand, the calculations show the advantage of a long stroke. With the same r.p.m. a long-stroke engine has a smaller cylinder bore and, consequently, a smaller specific speed than a short-stroke engine. However, there are limitations in both directions. If good combustion and good fuel economy are required, the stroke-bore ratio should not be much less than 1.5. On the other hand, in lengthening the stroke, with a trunk piston, which alone can be considered for high speed, a constructional limit is soon reached due to connecting-rod interference with the cylinder wall.

Assuming a stroke-bore ratio of 1.5 for both the four-stroke and two-stroke cycles, the respective speed limits for the two engine types are shown in Fig. 5, which shows the two-cycle principle to be decidedly superior. The maximum rotating speeds are twice as great for the two-stroke cycle as for the four-stroke cycle. The maximum piston speed was found to be 2,750 ft. per min. for the latter engine and 5,500 ft., for the two-stroke-cycle engine, assuming a 1.5 stroke-bore ratio. Only if we succeed in making the valve area in a four-stroke engine one-fifth of the piston area can we hope to equal the speed of the two-stroke-cycle engine. It is questionable whether this is feasible.

The volumetric efficiency at the limiting speed is 0.64 with the four-stroke cycle and 0.39 with the two-stroke cycle. But since the two-stroke cycle has double the working strokes for the same r.p.m., it will still exceed the four-stroke cycle in power output if the cylinder dimensions are alike.

The investigation did not reveal whether or not such high piston speeds are constructionally feasible. However, in view of the engine speeds of the present racing cars, such a development does not seem to be very far off.

A valuable byproduct of the investigation is the information regarding the most favorable port dimensions and charging pressures for various engine speeds. As a result of the calculations two-stroke-cycle engines of the same specific speed should use identical charging pressures. Present practice regarding charging pressures favors 1.5 to 2.5 lb. gage. According to Fig. 2 this corresponds to specific speeds 2,000 to 6,000. On the other hand, it can be verified that the specific speeds of most two-stroke-cycle engines fall within this range; this agrees with the theory. The fact that charging pressures as high as 5 to 6 lb. have not been found economical, is no contradiction of the theory, because the higher specific speeds that are required by these high charging pressures have not been tried.

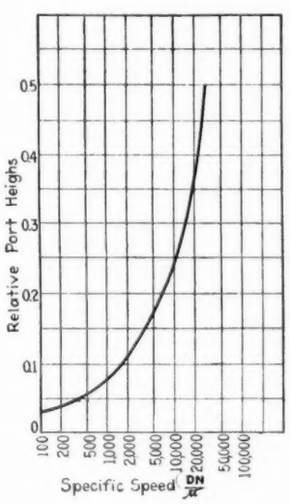


Fig. 3 — Relative port heights for two-stroke cycle

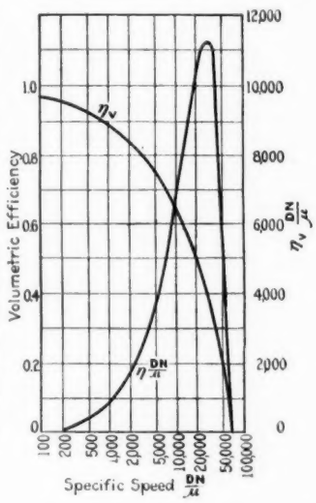


Fig. 4 — Influence of specific speed upon volumetric efficiency

The favorable results obtained with small charging pressures were generally attributed to the absence of turbulence and the resulting better scavenging. This explanation may be correct, but it is only an unproved hypothesis. In fact, the model experiments with glass cylinders do not seem to support this hypothesis.

With the relations derived by Doctor Holm between charging pressure, specific speed and output, the experimental observations can be easily explained without any forced hypothesis. Therefore, it can be expected that

the results of the computations will prove to be correct in the uninvestigated field of higher specific speeds. The negative results so far are probably due to the fact that, lacking experimental data and a basis for calculation, charging pressures and port heights have been chosen too small.

At very high speeds the port height should reach 50 per cent of the total stroke. This means that one should not be afraid to sacrifice half of the effective stroke for the intake and exhaust ports if best results are to be obtained. The mean effective pressure would still amount

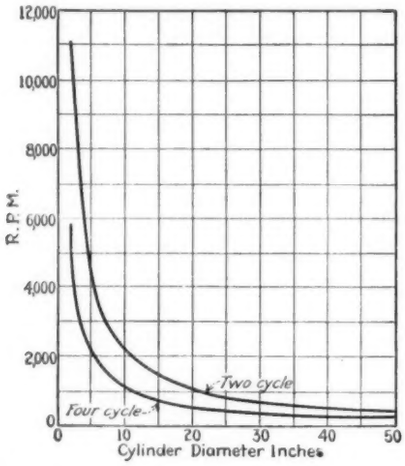


Fig. 5—Limiting speeds for both cycles

to about 30 lb. per sq.in. The scavenging should offer no difficulties because at these high speeds and low pressures blowers have very good efficiencies. Besides, a lower volumetric efficiency of the scavenging pump alters the theoretical results but little.

A Knowledge of Inertia Helped One Engineer

By A. B. Newell

IN A certain oil-engine power plant the solid-injection fuel pumps proved to be much more noisy than they had been on the test floor of the manufacturer, where they were run under conditions that were thought to be the same as the actual working condition.

The fuel pumps on these engines were cam-and-spring actuated, the cam making the delivery stroke and the spring returning the plungers on the suction stroke. The designers had carefully calculated the spring tension to overcome all inertia forces of the reciprocating masses in the pumps at a speed considerably in excess of the rated r.p.m. of the engines. The noise was, however, apparently the result of the springs failing to hold the rollers against the cams during the suction strokes of the pumps.

The first thought of the designers was to increase the spring tension, but when this was tried the rollers and cams started giving trouble and it became immediately apparent that the metal would not carry a greater spring load.

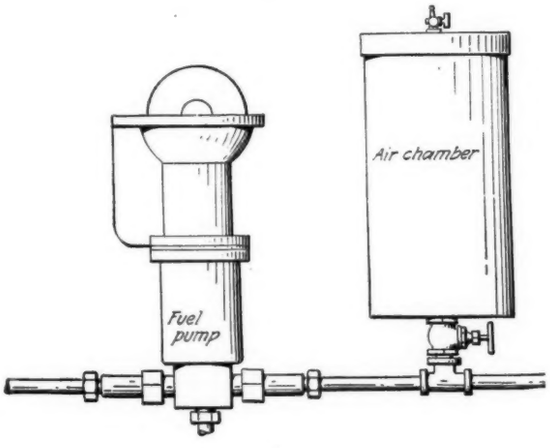
The next idea was to lengthen the cam on the suction side, giving the spring a longer time interval in which to bring the plunger back on the suction stroke. On later designs this was done, but on the engines in question it would have involved the removal of the camshaft and all the cams, a procedure not to the liking of the chief engineer, who did not care to delay operation.

The source of the trouble was finally traced to the fact that the fuel supply tank was installed at a considerably greater distance from the engines than had been the case on the test floor. As a result the hydrostatic head pressure was not great enough to set the column of fuel in the suction line in motion as fast as the fuel-pump plunger could take it away.

In the midst of heated argument and while pencils and slide rules were working overtime, the chief engineer cured the trouble by installing an air chamber in the fuel suction line close to the fuel pumps. His explanation was that this was not an air trap but was an air cushion. He claimed, in short, that the head pressure of fuel would cause it to flow into the chamber and compress the air to a pressure equal to that of the fuel at that point, and that the compressed air would in turn feed the fuel into the pumps through a short line in place of having to feed it under similar pressure through a long line of pipe. The correctness of his deductions was proved by the elimination of noise in the fuel pumps.

Subsequent developments proved that the fuel would take up and entrain a certain amount of air which would in turn empty the air chamber, and it became necessary to install a shut-off valve, a drain and a vent in the air chamber in order to recharge it with air from time to time, as shown in the illustration.

In another plant a similar difficulty occurred, involving the setting in rapid motion of a column of fuel oil. In this plant the fuel tank was installed at a far distant and high point, giving a head pressure on the suction line sufficient to charge the fuel pumps efficiently. The purchaser asked the engine builder's permission to do away



The air chamber increased the pump capacity

with the regular fuel tank on the engine and lead a pipe direct to the storage tank. The engine builder agreed to this after conducting experiments with a pressure on the suction line equal to that which was to be used in the actual installation and tuning up the engine accordingly.

When the engine was put in service, it smoked badly at the exhaust and all indications pointed to dribbling at the fuel nozzles. There was no doubt that the spring tension on the several check valves in the pumps and spray valves was sufficient to prevent fuel, under the pressure involved, from leaking through during the idle periods between strokes of the fuel pumps. The valves were in perfect

condition, yet they appeared to leak while the engine was running, although tests made while the engine was not running proved that the valves were tight and that the springs were strong enough to prevent them from opening.

The trouble was located by a service engineer who found that the fuel-pump bypass valves discharge line which should have been piped back to the fuel tank separately, was connected into the suction line. When the bypass valves opened, the discharge of fuel under great pressure was very sudden and set up a series of water-hammer, or pressure waves, which lifted the suction and delivery valves in the fuel pumps as well as the check valves in the spray valves. This permitted a certain amount of fuel to dribble into the cylinder during the idle stroke.

To overcome the trouble, it was necessary to pipe the bypassed fuel back to the fuel tank through a separate line. Probably an air chamber and elastic cushion of air would have overcome this difficulty had it been installed between the fuel pumps and the point where the bypass line joined the suction line of the pumps.

How to Operate Two-Stroke-Cycle Oil Engines in Parallel

By F. C. Williams

IN THE course of my work as erecting engineer I have seen a great many oil-engine plants in operation, many of them containing two or more units operating in parallel. Sometimes the performance has been good; frequently it has been bad. On being questioned as to the reason, the operator usually has laid the blame on the governors, saying the springs were not right.

I have been through this trouble myself and learned by experience that the surging of current between the units and the tendency of one or the other unit to hog the load, can be overcome by some simple fuel-pump manipulation.

It is safe to assume that an engine sent out for electrical service has been equipped with a governor designed for that service, and of course for parallel operation. This being true, it is unnecessary for the plant operator to go to the expense and trouble of getting expert advice on governor troubles when he finds the units of the plant bucking each other on the switchboard.

Practically all solid-injection fuel-pump systems come under one of two classes: The pump has a constant or fixed stroke and governor-controlled bypass; or the pump has a variable stroke, governor-controlled, and a fixed bypass. The former is the more common, but the result on the power delivery is the same in either design, and both give equally good results in the working of the engine.

When an engine leaves the factory, it has been tested to some percentage of overload and the pump adjusted for that condition. An operator soon discovers that no two engines will operate equally well on the same adjustment of fuel pumps, and the same is true of the pump adjustment on a multi-cylinder engine. Hence, it becomes necessary to readjust the valve-operating mechanism, and almost invariably the result of such a change is to give the engine more overload capacity.

The engine will then try to take more than its share of the load, and if the other engine has not received a similar increase in capacity, it will give up a portion of its share. If, however, both engines have a similar overload capacity, they will "buck" each other on the busbars, and while the governors are trying to steady this effort of each, a surge is set up between the generators, sometimes so strong that the service is seriously injured. I have seen plants where it was the practice to cut one cylinder out of service when necessity for parallel service arose, although the real remedy lay in the adjustment of the fuel pumps.

When these conditions come up, it is my practice to adjust the valve mechanism so that the engine will get just barely enough fuel from the pumps to carry the necessary load at rated speed. This may mean reducing the pump clearances advised by the manufacturer, but it must be kept in mind that those clearances give the engine a considerable overload capacity, and that it is this characteristic which is the cause of the "bucking" of the units.

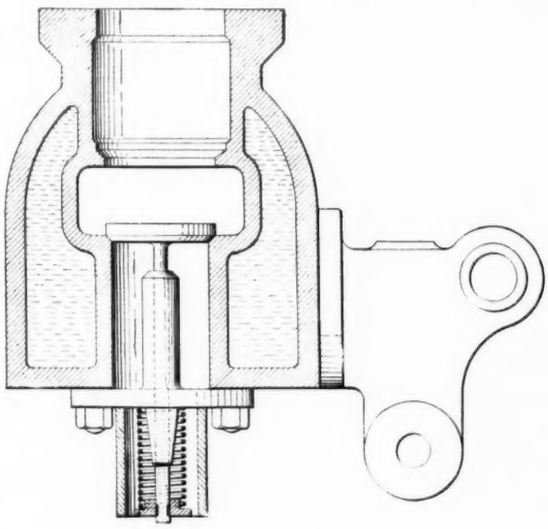
It may even be necessary to put more tension on the governor springs to compensate for the reduced fuel-pump capacity, but the result will be a smooth flow of power that will show up in steady and quiet movement of the switchboard instruments, cooler running generators and reduced fuel consumption.

I have seen plants in which the engines seemed to be seriously overloaded, where by proper adjustment of the fuel pump this could have been made to disappear.

Improved Exhaust-Valve Guide

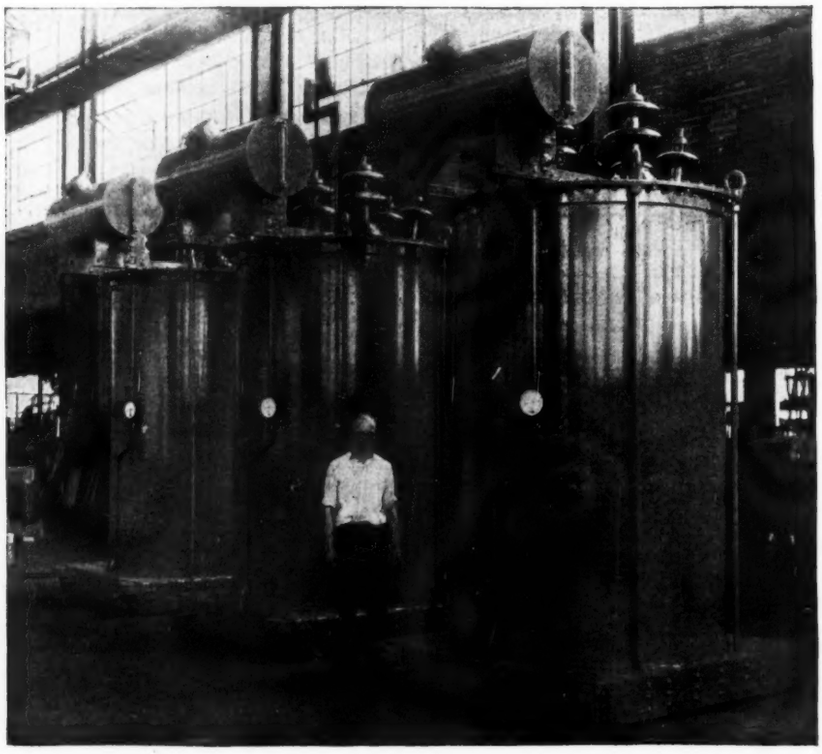
By H. Weiland Los

COMMONLY the exhaust-valve guide of gas and oil engines is a simple interchangeable bushing, inserted or removed through the inlet-valve cage opening. Thus the guide is internally located and is not readily removable, so that in many cases it is replaced only when the valve is badly leaking. Inaccessible parts are rarely given proper attention.



Valve guide

An improved exhaust-valve guide is shown in the illustration. This guide is externally bolted to the cylinder head and may be easily removed for inspection, repair or replacement.



Three 3,333-kva. single-phase transformers for 22,000 to 5,000 volts.

How POWER-TRANSFORMERS *Are Protected*

By E. H. Stivender

WHILE requiring little attention as compared with rotating machines for like service, transformers must be protected against overheating and internal faults. A number of different types of remotely located instruments and controls have been developed which facilitate these operations in modern power stations. Alarms to indicate incorrect flow of cooling water in water-cooled transformer banks are made to be located at considerable distances from the transformers. These, with remotely controlled temperature indicators and circuit breakers, suffice to centralize all operations in one control room.

When a large transformer or transformer bank supplies a single feeder independent of a secondary bus, overload trip protection for automatically opening the transformer circuit breakers is employed. Where the transformer supplies a number of feeders in multiple, no overload protection other than alarms and indicators is used, as a rule. In some of the later central stations and substations where several transformer banks with a primary and secondary bus supply a common load, transformers guaranteed to stand 100 per cent overload for a specified time are sometimes used. This practice makes it possible for one bank to be taken out of service temporarily without necessitating a reduction in load of the station.

Three single-phase transformers are used in many cases in preference to three-phase transformers. The former are easier to repair, and spare capacity is more readily provided in case of a breakdown of one transformer. The spare unit can be arranged to be cut into circuit by closing disconnecting switches or be mounted on rails so it can readily be moved into the defective unit's place.

Protection from overload is accomplished by fuses, temperature relays, overload relays and differential relays. The use of fuses is in general limited to smaller lighting and power transformers and instrument potential transformers. The expulsion fuse has wide use with equipment of the 2,200- and 6,600-volt class, also the cutout or plug type is used extensively for small-load services.

Temperature indicators and recorders are being used extensively. Recorders as a rule are furnished with auxiliary contact to operate an alarm or trip the high- and low-tension circuit breakers when the temperature reaches a certain point. Sometimes a separate temperature relay is used for this service. In this case it may

consist of contacts operated by a thermometer or by an instrument, depending for its action on a temperature coil or thermocouple inside the transformer. When a temperature relay is used for an alarm, it often indicates on the same annunciator as the water-flow alarms.

It is becoming general practice to regulate the load of a transmission bank by temperature indications, rather than to base it on wattmeter, power-factor meter and reactive kilovolt-ampere meter readings.

Fig. 1 illustrates schematically a temperature relay, with the trip circuit omitted. There are four resistor elements, *A, B, C* and *D*, connected to produce the effect of a Wheatstone bridge. The two coils *A* and *B* are copper exploring coils embedded in the windings or core of the transformer, and coils *C* and *D* are fixed resistance mounted near the relay element. The relay element consists of three coils, *E, F* and *G*, wound on a specially designed core of iron punchings. Coils *F* and *G* are in series and are connected across the junctions of *A-C* and *B-D*, therefore corresponding to the galvanometer of the bridge circuit. Coil *E* is connected across the current transformer and serves to complete the rotating-field circuit acting upon the revolving disk, which carries the contacts in the oil switch trip-coil circuit.

Because the bridge arms *A-C* and *B-D* are of equal resistance at normal transformer temperature, no current will flow through coils *F* and *G* and no torque will be exerted on the disk. This disk is held in the contact-open position by a coil spring, as in an induction-type overload relay. Should one exploring coil increase in resistance, as when the transformer windings increase in tempera ture, the balance potential across coils *F* and *G* is de-

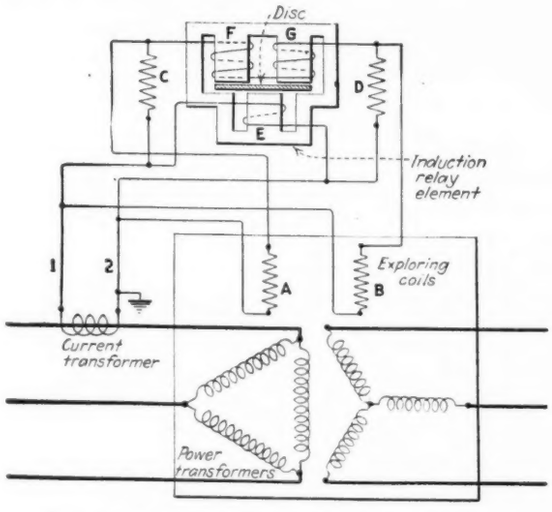


Fig. 1—Circuit diagram for a transformer temperature relay

stroyed and a current flows through them causing the disk to rotate, thereby closing the contacts.

With this type of protection the transformer must have a certain predetermined temperature, the load current must be equal to or over a certain value, and these two conditions must last for a determined length of time before the oil switch will be tripped. These characteristics make this a desirable type of protection to use with large transformer banks.

Overload relays may be used to trip the circuit breakers of individual feeder transformers only, and when used on a main bank operate either an indicator or an audible alarm to warn the operator of impending danger. It is then left to his discretion when the load shall be disconnected.

Reverse-power overload relays and phase-balance overload relays are also used for the protection of transformers. For opening the circuit breaker to prevent damage should a failure occur inside the transformers, differentially connected relays are employed. Depending upon the locations of the current transformers, the relays may also operate with a fault in any of the auxiliary equipment, as in circuit breakers and intermediate lead connections.

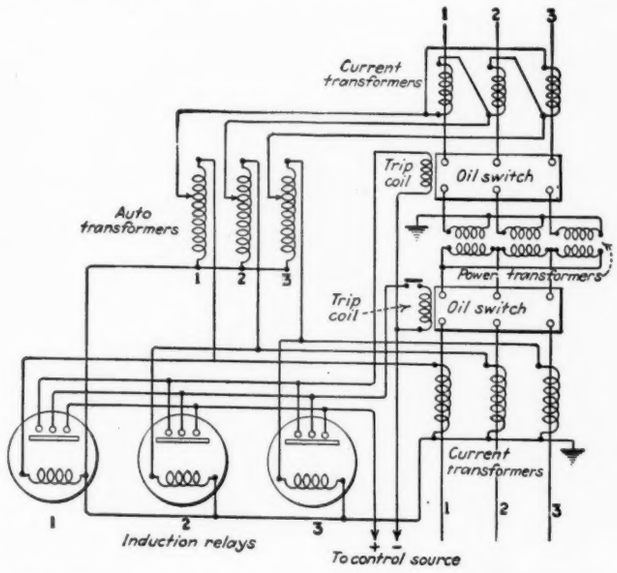


Fig. 2—Differential-relay connections for protecting a three-phase bank of transformers

Since the relays act immediately on low current values, they quickly clear the apparatus when an internal fault occurs. Fig. 2 is a diagram of such a system for a three-phase delta-star connected transformer bank, with protection of the circuit breakers also. Small auto-transformers are required where standard 5-ampere secondary-current transformers are used, owing to the required delta connection of the current transformers on the star side. These auto-transformers are made for a special current ratio which in this case is theoretically 8.66 to 5. With this arrangement of connections, as long as the correct current relation exists in two ends of each line, 1, 2 and 3, no current flows through the relay coils. Should any fault occur in the power equipment between the two sets of current transformers, current flows in a relay coil corresponding to the phase affected and the oil switches are opened.

Type of Relay Used

Low-energy inverse-time limit induction relays are used for transformer differential protection, as the effects of slight phase and ratio differences can readily be compensated for. Also load and switching conditions sometimes cause a momentary unbalance, which is not injurious but which would operate a relay that has no time element or induction characteristics.

For the most reliable service no instruments, such as ammeters or wattmeters, should be connected in the differential-relay current-transformer circuit. If instru-

ments should be put in this circuit, the total load on one current transformer should not exceed 30 volt-amperes for standard current transformers, and the unbalance should never exceed 10 volt-amperes. Ammeter switches should not be in the differential circuit in any case, for the difference in resistance of the contacts when operating may cause an unbalance resulting in the tripping of the circuit breakers.

The grounding of instrument-transformer secondaries at the transformers, wherever possible, is recommended in order to afford protection in case of insulation breakdown and to neutralize the effects of electrostatic induction.

How to Avoid Unsatisfactory Synchronous-Converter Applications

By R. E. Powers
General Engineer,
Westinghouse Electric & Manufacturing Company

IN GENERAL, the satisfactory operation of a synchronous converter depends upon its proper application, the effectiveness of the protective devices with which it is provided and the degree of maintenance given to the unit.

The synchronous converter possesses certain fundamental advantages in first cost, efficiency, weight and space requirements that have led to its wide adoption in the conversion of power for most types of railway, industrial and Edison service. In application where the synchronous converter is known to be entirely satisfactory, there is ordinarily little need for considering other types of conversion equipment for the service. However, in applications where synchronous converters have not been used, there are a number of factors that should be given due consideration in order that the converter may not be applied in a field where the operating conditions are such as would be detrimental to its satisfactory performance.

SYNCHRONOUS converters should not be used at the end of a long high-impedance transmission line or at any other location where the supply voltage is subject to sudden fluctuations incident to quick changes of large blocks of load, or to the clearing of faults.

The inherent stability, or "stiffness," of the alternating-current supply system has a decided influence on the performance of synchronous converters, and the characteristics of the supply line should be carefully ascertained before converters are applied in a given location.

Synchronous converters should not be used at the end of a long high-impedance transmission line or at any other location such as a sectionalizing point, where the supply voltage is subject to sudden fluctuations incident to quick changes of large blocks of load or to the clearing of faults.

If the total impedance drop of the transmission line is excessive, such as may occur in what is commonly known as "shoestring" feeders, the operation of synchronous equipment in general and synchronous converters in particular will not prove to be satisfactory.

Regulation of the transmission line affects directly the value of the commutator voltage as there is a fixed ratio existing between the voltage applied to the slip rings and the voltage taken from the commutator. Operation under conditions of high transmission-line regulation results in low direct-current voltage during periods of peak operations and high direct-current voltage during off-peak periods. In a number of cases operating records taken from 600-volt interurban railway installations show a variation from 550 volts direct-current during peak-period operation to 675 to 690 during off-peak periods at night, the voltage variation coming from transmission line regulation as the units referred to were of the compound-wound type operating in conjunction with 15 per cent reactance transformers.

Operation of standard synchronous converters at voltages in excess of 5 per cent plus or minus is not recommended. Overvoltage increases the volts per bar and makes the unit more susceptible to flashing at the commutator due to disturbance on either the alternating- or direct-current system. With a given field rheostat setting, the shunt-field current will increase in proportion to the overvoltage and may ultimately result in roasting out of a shunt-field winding or the burning out of the rheostat.

In order that a synchronous converter may carry load, its rotor must drop back in its phase position an amount sufficient to pass the current corresponding to the load losses, through the internal impedance of the windings and through the external impedance of the transformers and transmission lines. If the converter is supplied over low-capacity high-reactance transmission systems, this phase angle will necessarily be relatively large and will decrease the value of power that the converter can carry without falling out of step.

Rapid changes in the load of the alternating-current system will cause a rapid fluctuation of the voltage. If the total system load increases, the converter must deliver up its stored energy and drop back in phase position, while with a drop in system load excess energy must be supplied to the converter rotor to advance it in phase position so as to assume its proper position. If these changes in load are of a large magnitude and occur rapidly, unbalanced conditions are set up in the converter that may result in serious flashing at the commutator.

Improvement in Generators

The general improvement in alternating-current generating and distribution systems due to the growth of the large central-station industry and the better understanding of the general transmission system, has removed many of the conditions that are detrimental to the satisfactory operation of synchronous converters.

The synchronous converter acts as a connecting link between the direct- and alternating-current systems and supplies energy, within its capacity, in accordance with the demands of the direct-current system. A thorough analysis of the load characteristics of the direct-current system should be made and a converter having the proper

characteristics with reference to short-period commutating ability, temperature and overload limits should be selected for the application.

Ordinarily, in Edison, electrolytic or industrial service, the required converter capacity is determined by effective heating value of the load current rather than the momentary commutating capacity of the unit, as this type of service requires machines capable of operation at or near rated load continuously with the unit reaching a constant value of temperature after a number of hours' operation. However, in railway and mining service it is frequently the case that the capacity of the substation is dictated by the normal short-period peak requirements that arise from the operation of multiple unit trains on elevated, subways and electrified sections of steam lines in railway service or heavy main-line haulage locomotives in the mining industry.

In applications where load swings on the order of 300 per cent of machine rating are met in daily duty cycle and short circuits are of frequent occurrence, as in mining service, due consideration should be given to the motor-generator set which is inherently more capable of satisfactory operation under such adverse conditions. Comparisons from a first-cost, space and weight, maintenance and efficiency basis, should be made with due consideration given to such intangible factors as reliability of operation and availability for service.

Automatic Brake Permits Push-Button Control of Super-Synchronous Motors

AN AUTOMATIC brake, shown in the figure, for use with super-synchronous motors, obviates the necessity for manual braking of the rotating stator. The brake mechanism consists of an upright standard which supports a vertical shaft. The lower part of this shaft is threaded. When it is revolved, it transmits motion through a trunnion block to a series of levers attached to the brake band. The driving motor for the brake is mounted on the side of the standard and is geared to the screw shaft. A wheel is mounted on the end of the shaft, so that hand operation may be obtained at any time.

When the brake is being released, the trunnion block travels upward on the screw and is stopped by the tripping of a limit switch when sufficient clearance has been obtained between the brake band and the motor frame. In tightening the brake, the trunnion block moves down on the screw, automatically applying tension to the brake band through the combination of levers and weights until the action is stopped by a limit switch. It is impossible for the brake to apply more torque than the amount corresponding to the weights on the brake lever. By adjusting these weights it is possible to vary the starting time of the motor over a reasonable period; for example, from 5 to 40 seconds.

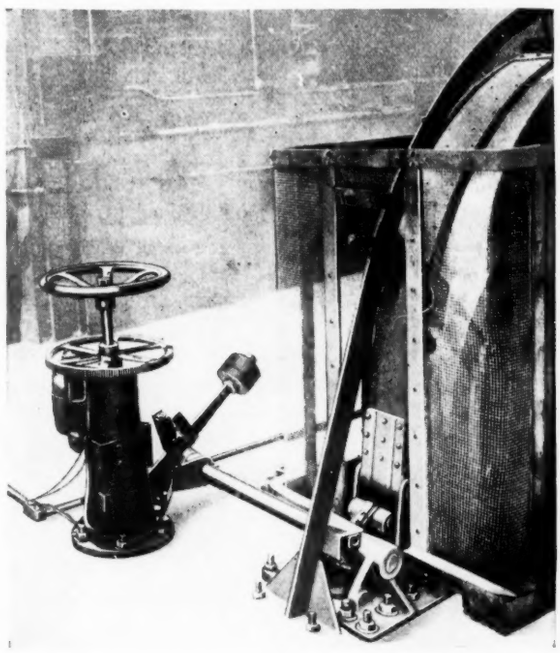
The balancing of the weight and the closing of the band around the frame take place gradually. Over two seconds elapse after the band makes contact with the frame before full tension is established. This does not include the time taken to remove the slack from the band, which requires a few seconds. The tension is applied at the same speed, regardless of the amount of weight on the lever. Consequently, there is no sudden application of torque to the driven machine. This makes a smooth start possible even when the brake is set for rapid acceleration. The two-second interval allows ample time for the application of torque to the load and still is not long enough to make the equipment sluggish when used to spot or jog the driven machine.

Any slight expansion in the brake band is automatically compensated for. When the stator frame is brought to rest and the load is up to full speed, the driving motor is again started and the brake band is given sufficient tension to lock the motor frame rigidly and prevent any slipping caused by shocks produced by the load.

Hand Operation Is Eliminated

With the automatic brake hand operation is eliminated except when desired. The super-synchronous motor may be started or stopped by a push button.

The super-synchronous motor on which this brake is used is designed by the General Electric Company for driving loads where synchronous motors can be advantageously used, where loads require more than full-load torque before synchronism is reached and on which it is desired to limit the power demand during the starting period to approximately full-load values. This is possible by reason of the fact that it is so constructed mechanically that its pull-out torque is also its starting torque. Typical applications are centrifugal and other pumps where bypass connections are omitted; air compressors where unloading valves are omitted; vacuum pumps; mine fans and other large blowers; crushing, grinding and pulverizing machinery in cement mills, rock-crushing plants and ore-dressing mills; paper-mill pulp beaters; flour-mill lineshafts; rubber-mill limeshafts; machines characterized by heavy flywheel effects, and machines that are difficult to start when stopped loaded with material.



Motor-operated brake on super-synchronous motor in a cement plant

IDEAS FROM PRACTICAL MEN

For the exchange of practical information and ingenious expedients in operation and maintenance of plant and equipment

Supplying Oil Fuel from a Central Point to a Number of Services

WHERE oil is used for fuel in the various divisions of a large industrial plant, difficulty is frequently had in keeping it at a proper temperature to flow freely in the pipe line. This trouble is increased where the oil is supplied from one point and distributed through long pipe lines. We encountered this trouble when our plant was first started, and, after some experimenting, concluded that the simplest way to overcome it was to arrange the pipe in the form of a loop.

The full line shows how the original supply line was laid out connecting the three boilers in the power plant and the forge, blacksmith shop and heat-treating plant. The dotted line shows the return line, or the completion of the loop. With this arrangement considerably more oil is circulated than can be utilized at the various points,

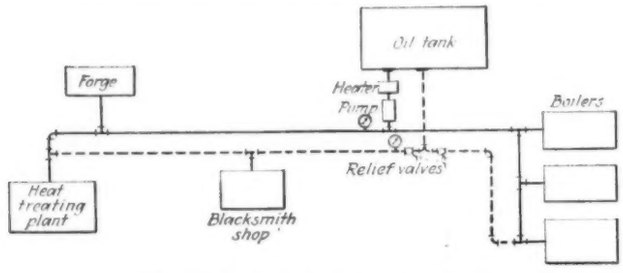


Diagram of piping arrangement

and as a result the temperature and viscosity are maintained at the proper point for best results. The line to the blacksmith shop was disconnected from the original line and joined permanently to the return line.

Buffalo, N. Y. B. C. ALLAN.

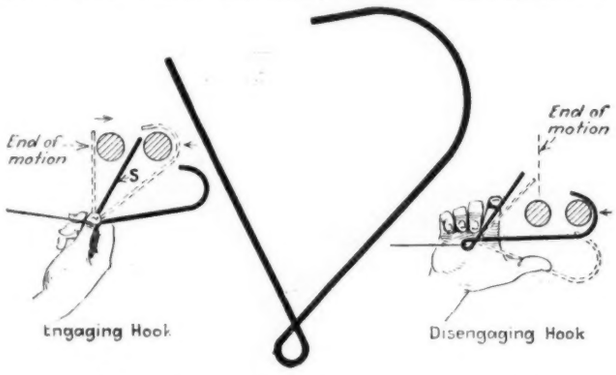
Practical Hook for Indicators

I HAVE used many types of hooks for attaching indicator cords to the crossheads of steam engines. Some of these were excellent for slow-speed engines, but were a real hazard when used with high-speed engines. Often the choice of a hook is what one accidentally gets started with and becomes fairly proficient in its use, so that what appeals to one may be worthless to another. Several hooks that I tried straightened out under the tension of the indicator, showing that certain metals are best suited for this work.

The hook that I have found best suited for all purposes is illustrated herewith and is made of phosphor-bronze wire of about $\frac{1}{16}$ in. in diameter. It is used as follows:

To engage the indicator: Grasp the loop between the thumb and first finger and hold the straight section *S* at the near end of the travel of the crosshead rod connection to which the indicator is to be attached, so that it will just barely strike this straight section. With the loop as a fulcrum the slight movement of the hook causes the hook end to move toward the rod, so that upon the return stroke of the rod the hook is taken out of your hand by the rod, automatically.

To disengage the hook: With the open palm of the right hand held up, move the hand slowly toward the end of the stroke of the crosshead rod until the first finger just touches the straight section of the hook *S*.



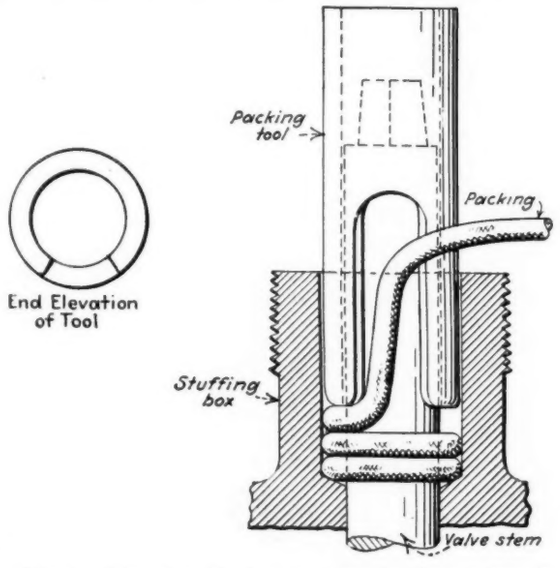
How the hook is engaged and disengaged

The tension of the indicator cord, with the finger as a fulcrum, immediately pulls the hook away from the rod, which then returns to its regular stroke leaving the hook in your hand. L. G. JONES.

Pittsburgh, Pa.

Handy Valve Packing Tool

A HANDY packing tool for quickly placing the packing around valve stems is shown in the illustration. It is made from a short piece of steel tubing of a suitable size to enter the stuffing box and slip easily over the



Tool in position for placing packing in the stuffing box.

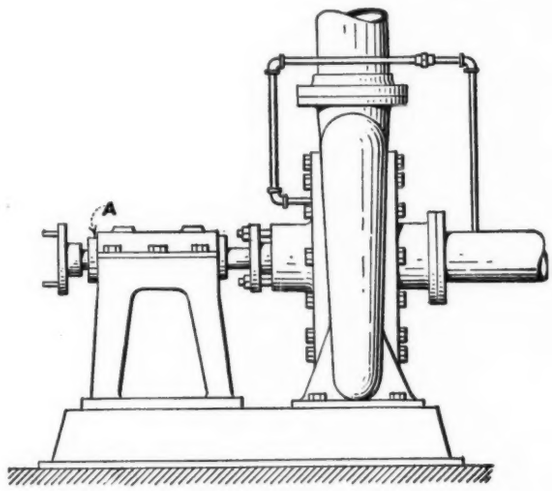
stem. An opening is made in one side of the tube through which the packing passes as the tool is rotated. In use, the end of the packing is started in the usual way and the tool is used to force the packing down until the stuffing box is filled. This is a rapid and time-saving tool.

Syracuse, N. Y. H. L. WHEELER.

How Trouble from End Thrust in a Single-Suction Centrifugal Pump Was Overcome

THE illustration shows an inclosed propeller type of centrifugal pump with which we had a great deal of trouble owing to the impeller being pulled over against the suction side of the pump casing.

We tried a thrust bearing on the outer end of the bearing in place of the thrust collar as at *A*, but owing



Bypass from suction to bearing side of impeller stopped end thrust

to the short life of the thrust bearing it was discontinued.

The trouble was finally overcome by connecting a ½-in. bypass from the suction pipe to the other side of the impeller, as shown. This removed all the end thrust from the pump shaft except what could be taken care of by the thrust collars. W. W. TROUTMAN.

McNary, Ariz.

Preventing Vibration in Electric Motors

VIBRATION in motors is not uncommon and may be the cause of breakdowns in the windings, as it will tend to loosen the connections and injure the insulation. Brush chattering may result, and in high speed machines the brushes may be chipped and broken.

Vibration may be due to a defect in the motor itself or may be transmitted from the connected load. An armature out of balance, electrically or mechanically, may be the cause. As the manufacturers make tests at their works, these faults should be detected by them. A bad surface or an eccentric commutator will create vibration at the brushes, which increases as the speed rises. Too much play in the bearings may also be the cause. An unequal air gap between the polepieces and armature will cause an unequal magnetic pull by the different field poles, which will increase the wear at the bearings and may produce vibration.

The origin of vibration in an induction motor with a squirrel-cage rotor, was found to be several high-resistance joints in the rotor circuit. These caused the rotor to be electrically unbalanced. When the defective joints were located and repaired, the vibration disappeared.

Vibration may also be produced by poor joints in the driving belt, which gives a jolt each time a joint passes round the motor pulley. Where the motor is connected to its load by a chain drive, if this is poorly lubricated or improperly adjusted, it will vibrate when running. Where the motor is connected by gearing, a flexible coupling should be used, as gears cause considerable vibration, especially if not properly lined up and lubricated. Where the motor is direct-coupled to its load, if it is at al. vibrating, a flexible coupling should be used.

Insecure foundations or loose holding-down bolts are also possible causes. The whole machine may vibrate owing to the vibration of its foundations; a remedy for this is increasing the weight on the bedplate. In one instance vibration was materially reduced by placing two 112-lb. weights on each side of the bedplate. Afterward, a layer of lead was run into the bedplate, and this cured the trouble.

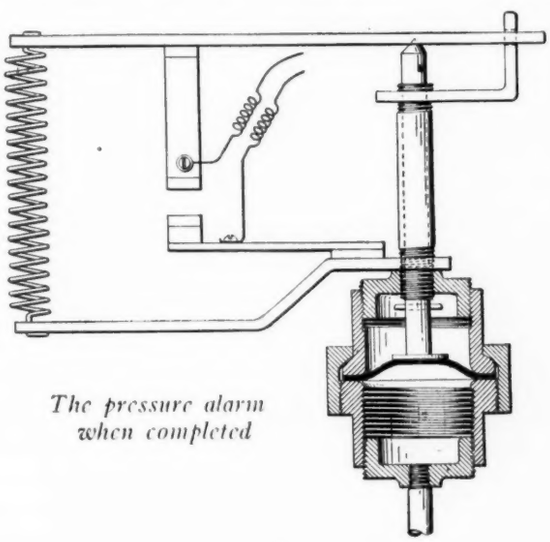
In many armatures it is the practice to use fiber spacer blocks between the coils. These blocks are secured by rivets. I have known cases where vibration has caused these blocks to become loose. In one instance one of these blocks fell out and was carried between the armature and field coils. This damaged the insulation on all the armature coils and made rewinding necessary. The cost of this was many times greater than a flexible coupling which, if it had been fitted, would have damped out the vibration. W. E. WARNER.

Brentford, England.

A Pressure Control That Is Good

RECENTLY, I made a switch control of a two-inch union, to be used on a pressure line where the pumps were connected to tanks, pits and other places where a pump is likely to become unprimed.

By taking a lip-joint union, such as is used in waterworks lines, and cutting the lips off, I made two plain



The pressure alarm when completed

flanges, which were held together by the nut as shown in the illustration. Between these flanges I placed a piece of ⅛-in. rubber gasket to cover the full opening of the union. Against this I placed a plunger which has a pin set in the stem to prevent the plunger from rising too high. The upper end of the plunger rested against a piece of strap iron to the other end of which was fastened a spring. The movement of the plunger opens or closes the electric contact. CURTIS GIBBS.

Wichita Falls, Tex.

COMMENTS FROM READERS

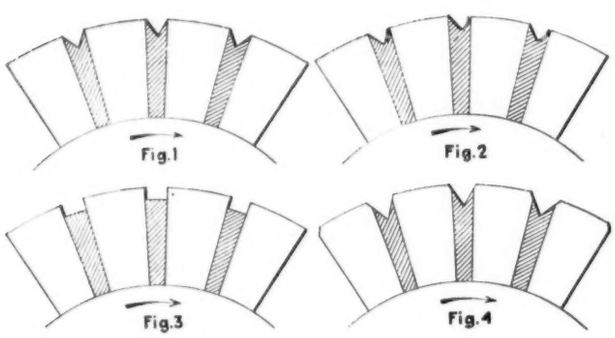
In which those who agree and those who disagree, with either authors or editors, are afforded an opportunity to express their views

Objects to V-Shaped Slots in Commutators

IN THE May 22 issue I read H. E. Stafford's article on "Hand Tools Used for Undercutting Commutators," and desire to make a few comments on it. My experience with direct-current machines would indicate that it is poor practice to undercut a commutator with a V cutter or file.

The reason for undercutting a commutator is to get rid of the flush mica so that non-abrasive brushes can be used, and so prolong the life of the commutator. By using a V-shaped slot, Fig. 1, the purpose you are trying to accomplish is partly defeated.

When the slot is cut out with a V file or cutter, the mica, close to the segment, is cut a few thousandths of an inch only below the surface, and by the time the commutator has worn to a polish there is high mica on each side of the slot. When the mica is left flush, it is supported on both sides by the copper segments and so does not flake or fan open.



Figs. 1 to 4—Types of slots used in commutators

Fig. 1—V-shaped slot. Fig. 2—Mica on one side of V-shaped slot tends to leaf as indicated on the right side of the slot. Fig. 3—When the mica is cut down clean on the two sides of the slot there is no place for dirt to lodge. Fig. 4—A deep V-slot is objectionable as it reduces the contact surface between the commutator segments and the brushes. If the brushes are thin, the reduction in the width of the segments may cause them to rock in their holders.

When the center of the mica segment is cut away, its outside layers are not supported near the commutator's surface, and if the copper is worn down, the mica fans out into the slot, as in Fig. 2, so that any dirt or carbon dust lodging there is held. This causes short circuits and burned out armature coils. In my work as service man for an electrical machinery company I have found armatures burned out from this cause.

I have also found many cases of commutator troubles and brush sparking which were directly caused by V-groove undercutting. When the mica was cleaned out of the slot for about $\frac{1}{32}$ in. deep, as in Fig. 3, and the commutator stoned smooth, the troubles ceased.

I had one case in particular on a 200-kw. 230-volt three-wire generator, which caused a large amount of trouble, the commutator having to be turned three times in one year. There were three or four kinds of brushes tried and quite a few other remedies used, but still the trouble existed. For over a year since truing this commutator and properly undercutting it and polishing it, they have had no trouble.

CHARLES W. WARD,
Kansas City, Kan. Independent Electrical Machinery Co.

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A Notebook of General Formulas Saves Time

IN THE May 15 issue, under the title "A Notebook of General Formulas Saves Time," G. F. McClay gives some interesting observations on such a notebook. I have found it profitable to go even a step farther than the formula in certain cases where the solution of an oft-encountered problem, by actually plotting a curve or graph on a data sheet, so that, with one factor known, I can read off the answer by tracing it down to the other ordinate on a curve intersection. By such a procedure, I eliminate all calculations "in the field."

In addition, I increase the value of such a notebook by making textbook references on certain subjects, where the information is not reducable to a simple formula. As a further check, I not only give the textbook reference by page or chapter, but also the source of the book—whether public library, plant library, a fellow employee's book or my own. In this way I can quickly refer to a given subject by tracing it under the alphabetical heading in the book.

LEON J. LICHTENSTEIN.
Philadelphia, Pa.

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Who Designed the Boiler House of the Longview Fibre Company?

MY ATTENTION has just been called to the article on pages 723, 724, 725 of the April 24 issue of *Power*, descriptive of the plant of the Longview Fibre Company. I consider this to be a very good description of the plant with the exception of the last paragraph. You have assigned to the office of which I am manager, the credit of the designing and installing of this plant. The design and construction of the boiler plant, as described in your article, should be entirely credited to the Longview Fibre Company engineering organization, of which C. R. Seaborne was the directing head. Our work consisted solely in the design of the furnaces for the direct-fired boilers and the furnishing, as representatives of the Babcock & Wilcox Company of the six Stirling boilers and, as contractors, installing them and their brickwork with superheaters and soot blowers on foundations that were furnished by the purchaser.

I advise you of this so that you can make correction in your columns and so that we will not receive credit for anything but that which is properly due us.

This installation has been a success in every way, and to the Longview Fibre Company engineering and constructing organization belongs all credit.

H. W. BUCHE, Manager Seattle Office,
Seattle, Wash. C. C. Moore & Company, Engineers.

What Happens When Steam Comes in Contact With Large Surface of Cold Water

ON PAGE 523 of the March 20 issue there was a description of an old boiler used as a water storage tank for fire protection. I am led to wonder what happens when steam is turned into this boiler and strikes this large surface of cold water.

My experience would indicate that there might be some pressure exerted on the water line, but also a decidedly dangerous water hammer. Probably some reader could give me a few pointers on this subject.

Racine, Wis. J. J. WYNHOFF.

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Why Some Plants Operate at Poor Efficiency

IN THE March 13 issue, there appeared an article about the savings effected in the power house of a paper mill, enumerating the several things that had been done in order to obtain the increased economies. On reading the article, the impression is left that there must have been something decidedly amiss with the operation of this plant if we are to judge by the character of the many ordinary things the consulting engineer found necessary to do.

"Leakage losses in the blowoff line were observed."

Is it possible that the operating engineer was not capable of observing losses in the blowoff line? Leakage will develop in blowoff valves, but provided with one extra set, so that the leaky ones can be replaced with a reground and repacked set each time a boiler is taken off for cleaning, the leakage losses can be kept to a minimum.

"The setting, upon being candled, showed leaks."

Is it possible that it was beyond the ability of the operating engineer to perform this simple operation? Or is it possible that the management would not provide him with a dime's worth of candles or a piece of oily waste on a stick or a piece of scrap pipe and a couple of fittings, to make a "Bunker Torch"?

"These (the leaks) were stopped with . . . "Airtite."

Is it possible that the management would not provide the engineer with some "Airtite" or that he himself could not have begged or borrowed a bucketful of coal tar or other substitute?

"Leaks were discovered in the breeching . . . the seams were closed with "Smooth-On."

If the engineer had previously been unable to obtain a supply of "Smooth-On" for this purpose, a few cents of his own money would have bought a pound of sal-ammoniac. This, mixed with a shovelful of cast-iron borings from the dump at the machine shop and a little water added, would have made a simple and effective substitute.

"The joints were closed with asbestos cement."

The lack of this high-grade material need not have prevented the engineer from keeping the joints closed up; surely, around a plant of this size enough material of some kind might have been found.

"The bridge walls had been omitted."

"There were no doors on the ashpits."

If both of these things had been overlooked in the original layout (and the writer has seen some startling omissions in original layouts), the operator would be in no sense responsible, although the need of them, and in particular the ashpit doors, should have been apparent over a short period of operation.

"Considerable of the old firebrick needed replacement."

"The rear doors, through which air leaked."

"The side doors had new linings placed in them."

"The jet ash conveyor, which had never been used, was put in operation."

"Other minor changes, . . . better illumination, . . . new boiler tools."

My contention is that nearly all the things enumerated were matters of purely routine maintenance and should have been taken care of by the operator (if there was one), and the fact that they were not, would indicate that he was either woefully lax or was working under extremely adverse circumstances.

"And finally, better operating methods were put in force."

Reading between the lines throughout the article and picturing the conditions, one is impelled to think that perhaps that line should be amended thus: "And finally, better operating *and management* methods were put in force."

To erect a comparatively modern power plant, such as this was, and then allow it to get into the dilapidated and neglected condition indicated, was, to say the least, deplorable and, surely, could not have been without some knowledge on the part of the management.

Chicago, Ill. S. M. QUINN.

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How About the Man?

IN THE May issue, F. M. Reiter takes a somewhat pessimistic view of the effect of increased production per man due to machine developments and a reduction in the number of men employed.

As suggested in the editorial "How About the Man?" in the same issue, one must take a bird's-eye view of the situation; and if we look back over a period of one hundred years we know that the production per man has increased by leaps and bounds with by no means a corresponding decrease in the number employed. So far in our history, man power released through machine improvement has been absorbed into new industries. In fact, if it were not so we would not be enjoying a state of material advancement that is not to be found anywhere else.

There was a time when a man and his wife could house, feed and clothe a family by working from dawn until dark, and they could provide little else. The invention of a simple machine released them of part of their labors so that they could produce not only more but other things for their comfort and enjoyment. The development of this new industry was followed by increased production per individual, which again released labor for the development of a third comfort, and so on, decade after decade.

When the automobile was invented and the industry grew rapidly, thousands of machinists were required and these were taken from industries which could release them through machine development in those industries. The growth of radio must have taken man power from other industries, which in turn could release them through machine development. Ahead of us is the development of the airplane, the magnitude of which can only be imagined.

In other words, the more man power released from

existing industries the more there is available for new industries, developing new comforts and new enjoyment. If this were not so, we would have to raise an entirely new crop of skilled workers with each new industry, which is manifestly impossible.

If one is inclined to be pessimistic, one might anticipate a time when, as a people, we have reached the pinnacle of material development and no industries will be developed to absorb the labor released from the old. One is occasionally inclined to ask oneself "What next?" because imagination has hardly been able to keep pace with invention.

If one compares the total purchasing power of the country with that of a generation ago and also compares retail prices, one must be impressed with the fact that the actual wealth per capita has increased and that the only explanation is through the average increased productivity of the individual through machine development. It is not uncommon to find wage earners working in industries entirely different from those in which they were engaged ten years ago, and their actual purchasing power is greater. Individuals and families may suffer certain hardships and some may find difficulty in adjusting themselves to changed conditions, but taken as a whole our extraordinary material advancement can be accounted for through the constant improvement in machine output.

Providence, R. I. WARREN B. LEWIS.

* * * *

Turbine-Condenser Connections

PROGRESSIVE power-plant designers are gradually getting away from rigid connection between turbine and condenser in order to eliminate as far as possible excessive strains and vibration transmission.

It is quite possible that some of the failures of turbines that are not directly traceable to external causes such as steam quality, steam piping strains, etc., may be traced to improper connections of the turbine exhaust.

There has been considerable study of the many ways in which ordinary turbine operation and maintenance cause high stresses from temperature changes in the various parts of the exhaust. Sometimes this is brought about by unequal heating of the different parts of the exhaust during the warming up and light-load periods. Sometimes abnormal strains are induced when the turbine cover is removed or when the condenser is filled fully or in part with water on the steam side for tube testing, or when rigid auxiliary piping is connected to the condenser or exhaust.

However, there is little record of study on the vibratory stresses transmitted through a rigid turbine-condenser connection. Engineers seem fully to realize the importance of isolating the turbine base from surrounding structural connections, but they neglect in many installations of large size the manner of rigidly connecting the turbine exhaust to a massive condenser.

Foundation designers seek to obtain mass effect in their foundations only at the foundation base, with the lighter portions of the foundation at upper portions of this structure. If the upper portions of foundations are made heavy, they tend to assume pendulum effects in vibrations; and for this reason the weights suspended from the foundation top should be as light as possible.

Good mechanical design does not place excessive tension strains in cast iron. By hanging the condenser weights on cast turbine nozzles, these connections and the parts so connected, including the condenser body and turbine, are subject to prohibitive tension strains. These condensers, under variable connection strains, are subject to considerable trouble from tube leakage and air leakage also.

Good mechanical design does not make use of springs, expecting that they will be both sensitive and uniform throughout long life. Maintenance instructions with spring-supported condensers usually specify that the supporting springs should periodically be carefully tested; but this rule is also rarely observed.

Columbus, Ohio. BASIL W. DENNIS.

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ANSWERS to "What Do You Know"

The questions are on page 1093

Ans. 1—Yes. Such valves, which are essentially two valve disks mounted on a spindle and two seats contained in the valve casting, are on the market. The closing action depends on the fact that the increase in flow above a predetermined value through the valve sets up a pressure difference on one of the disks so that the disk is found against the seat.

Ans. 2—The horsepower varies with the cube of the speed; if X be the horsepower at 100 r.p.m., then $\frac{X}{20} = \frac{100 \times 100 \times 100}{50 \times 50 \times 50}$, or $X = 160$ horsepower.

Ans. 3—The increase is greater in the engine. This is for the reason that in the reciprocating engine initial cylinder condensation accounts for much of the thermal loss and superheating eliminates this condensation.

Ans. 4—With the radiator in this position, the warm air rising from the radiator mixes with the cold air leaking in around the window, thus insuring a fairly uniform air temperature in the room.

Ans. 5—This is possible if there is an initial section of the grate of the overfeed type, so that the burning coal from this portion can be deposited on the traveling section.

Ans. 6—Yes. The reduction ranges from 10 to 35 per cent, increasing with the width of the shelf.

Ans. 7—The mercury will rise to a value slightly above the true steam temperature; then, as the glass bulb slowly expands, the mercury column will drop back to its true position.

Ans. 8—No. In all probability the heating of the hub would cause it to close in, since the heavy disk would prevent outward expansion. The correct method would be to heat the hub, while keeping the disk below room temperature by the application of ice.

Ans. 9—It will bend so that the edges rise upward. This is for the reason that the lower side, being heated, expands more than the upper side.

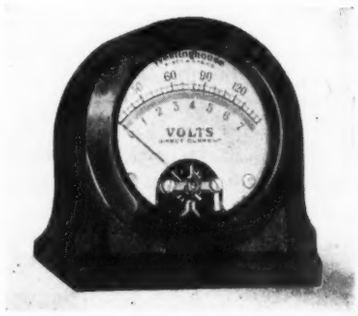
Ans. 10—Yes. The sound waves consist of alternate compressions and expansions of the air. As the expansion and compression take place with rapidity, there is no possibility of the air giving off or receiving heat; consequently, the action is adiabatic, resulting in a series of temperature increases and decreases. The changes, however, are too small to be measured by ordinary instruments.

PLANT EQUIPMENT NEWS

New and improved equipment in power and industrial plant fields, and new applications of existing equipment

Westinghouse Portable Direct-Current Instruments

A NEW line of portable direct-current instruments has recently been developed by the Westinghouse Electric & Manufacturing Company,



Type PX-2 Portable Double-Range Voltmeter

East Pittsburgh, Pa. These instruments, known as type PX2, are particularly suitable for miscellaneous testing.

They are of the permanent magnet moving-coil type and operate on the D'Arsonval principal. The moving coil rests on hardened steel pivots moving in sapphire jewel bearings. The mechanism is mounted on a molded micarta base and has a case of the same material. A mirrored dial and a knife-edge pointer facilitate accurate reading.

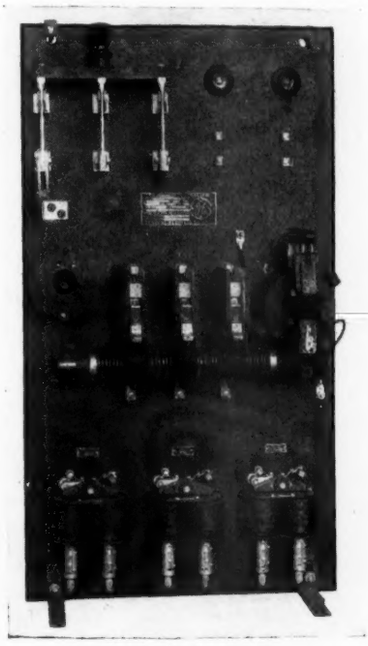
This line of instruments includes millivoltmeters, double-range voltmeters, milliammeters, ammeters, radio-frequency ammeters, and galvanometers.

Crane Panels Take Less Room in Cab

THE General Electric Company announces the revision of its line of crane protective panels bearing the designation CR-17409. Such panels provide overload and undervoltage protection for all the motors of a crane and are designed to be used with an emergency switch for use by the operator in an emergency. They may be used with either drum switches or magnetic control panels.

The principal change in the revised line is a regrouping of the units involved, resulting in a decided reduction in total size. This is considered an advantage, as the space in most crane cabs is limited. Another change is the substitution of instantaneous overload relays instead of dashpot overload relays.

The crane protective panel, shown in the figure, consists of a triple-pole line switch with a lockout device, a triple-pole line contactor, a reset push button, gravity-reset instantaneous overload relays, control fuses and two pilot-lamp receptacles, all mounted on a compound base. For 440- and 550-volt service a resistor of suitable size is also provided in series with the pilot lamps, so that standard 115-volt lamps may be used.



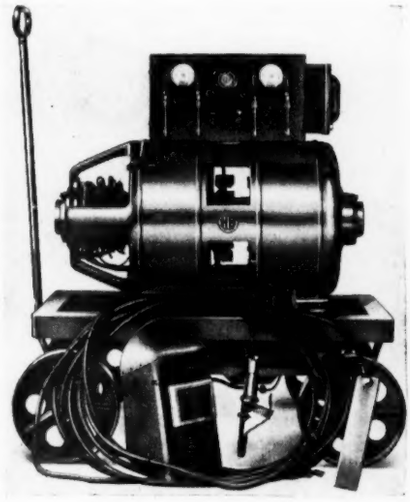
Front view of crane protective panel

When drum controllers are used, undervoltage protection is provided by wiring the control circuit through the reset points on the drum switches. This prevents the operator from closing the line contactor until all the drum switches are in the off position. Overload protection is provided by a double-coil overload relay in the lines to each motor, with one coil in each of the two outside leads. The lockout device has space for three padlocks and may be locked open by each of three workmen to prevent the crane from being started before the workman has completed his work and removed his padlock.

Hobart "HB Constant-Arc" Portable Electric Welders

COMPACT, unit-type construction is a feature of the portable electric welders put out by the Hobart Brothers Company, Troy, Ohio. The welders are made in two sizes, known as HB No. 45 and HB No. 46, with capacities of 10 and 15 hp. respectively. The No. 45 machine is illustrated.

The motor and generator are built together as a single unit. The motor can be furnished for two- or three-phase operation on either standard or odd voltages and cycles. The generator is of the constant-potential single-



H.B. No. 45 welder

commutator type and is self-exciting. The rotor of the unit is mounted on anti-friction bearings. Diverter-type windings perform the combined functions of voltage regulator and interpole windings to produce sparkless commutation. The current of 175 amperes on the small machine or 300 amperes on the larger machine can be controlled by a series of resistance in addition to that obtained by the voltage regulator.

Metallic electrodes from $\frac{1}{6}$ in. to $\frac{1}{4}$ in. can be used on the smaller machine, while the larger unit makes use of electrodes from $\frac{1}{4}$ to $\frac{1}{2}$ in. Carbon electrodes can be used on the No. 45 outfit up to $\frac{3}{8}$ in. in diameter and to $\frac{3}{4}$ in. in diameter on the No. 46. The weights of the two machines are 1,075 and 1,225 lb. respectively.

Campbell Steam-Flow Controllers

ALTHOUGH developed primarily for regulating the steam flow to oil stills, the steam-flow controller illustrated, introduced by the Campbell Engineering Company, Short Hills, N. J., is adaptable for controlling the flow to a variety of other services. The controller is being made in the single and twin orifice types, as illustrated in Figs. 1 and 2. It consists essentially of a combination of receivers, calibrated nozzles and recording or indicating instruments.

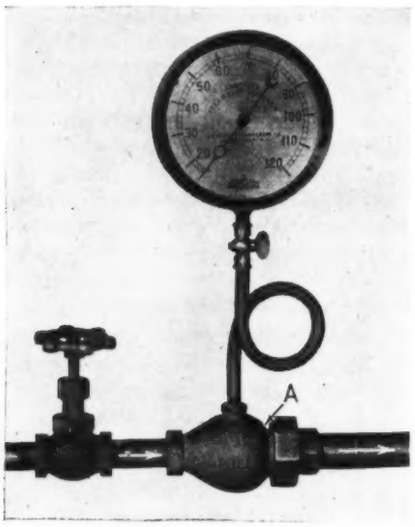


Fig. 1—Controller with single orifice and indicating gage

The type shown in Fig. 1 is used where relatively small flows are desired. It is fitted with a single calibrated nozzle at the discharge *A* of the receiver and with an indicating gage or flow indicator, which shows the flow directly in pounds of steam per hour. When proportionate flows to two points are desired, two receivers, two orifice nozzles and one recorder or indicator may be combined, by connection with a common pipe, into a double controller. Where large quantities are used, the one shown in Fig. 2 is employed. This unit is fitted with calibrated nozzles at *B* and *C* and is designed to proportion the flow to two points in the ratio of the orifice area.

Other uses for the controller are the regulation of steam to gas or oil burners, the distribution and control of steam for drying processes, heating buildings, and, in general, to regulate the steam to any point where an appreciable drop in pressure is permissible.

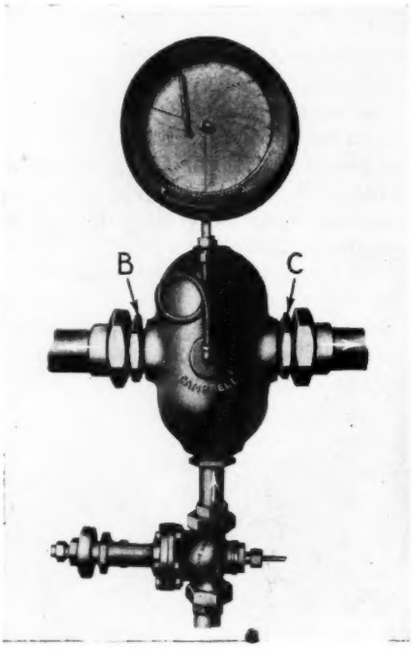


Fig. 2—Twin orifice type with recording instrument

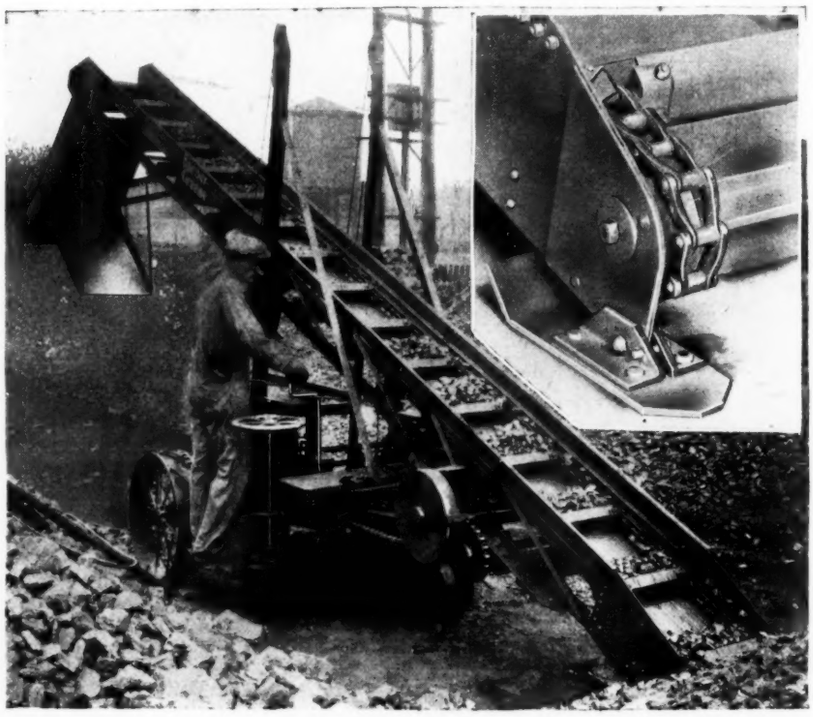
Barber-Greene Power-Propelled Flight Conveyor

A RECENT addition to the coal-handling equipment manufactured by the Barber-Greene Company, Aurora, Ill., is the power-propelled flight conveyor illustrated.

The machine is being put out in two sizes 24 and 30 ft. long. The trough of the conveyor is 21 in. wide and 11 in. deep, and the flights are 16 in. long and 4 in. high.

The important feature of the new machine is that it is power-propelled or self-driven, making it suitable for operation by one man, as all the controls are grouped conveniently at one point on the side of the conveyor. The machine is driven by a $7\frac{1}{2}$-hp. 1,800-r.p.m. motor or a 9-hp. 2-cylinder gasoline engine, and has a traveling speed forward or into the pile of 29, 54 and 92 ft. per min. and a reverse speed of 24 ft. per min. Traction is by means of a three-wheel truck, two 30x8-in. wheels being used for power and a smaller one for steering. The traction wheels can be driven together or individually for turning. The wheels can also be swiveled when not engaged.

Cup-shaped flights of $\frac{3}{16}$-in. steel are suspended from malleable-iron drag-type chains having a travel speed of 125 ft. per min. Arrangement of the drive is such that the conveyor line can be kept in motion



Power-propelled conveyor readily operated by one man

when crowding the conveyor into the pile or raising or lowering the boom by the power hoist.

The machine is equally adaptable to trimming and reclaiming, as the height of the boom is readily adjustable for a range of heights. The maximum height of discharge on the 24-ft. machine is 15 ft. 10 in. and in the 30-ft. machine 17 ft. 6 in. to the center of the head shaft. The conveyor is equipped with a gravity screen over which the material slides at the discharge end of the boom. It is also equipped with a chute for discharging the screenings.

The power hoist is of the self-locking worm-gear type totally inclosed in a cast-iron housing with the gears running in an oil bath. The capacity of the new unit is given as a ton of coal a minute under ordinary conditions, and it is adaptable for handling lump as well as fine coal.

Nugent Portable Motor-Driven Continuous-Flow Oil Filter

A RECENT addition to the line of oil filtering equipment put out by William W. Nugent & Company, 410 N. Hermitage Ave., Chicago, Ill., is

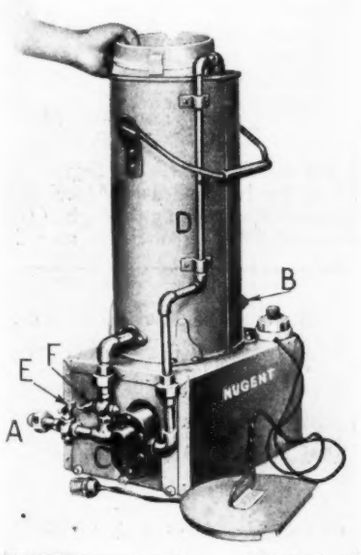


Fig. 1—Assembled view of filter without stand

the portable motor-driven filter with a capacity of 6 gal. per hour, illustrated.

The new filter is especially adapted for filtering the oil from any inclosed type of machine, such as reduction gears, engine crankcases and similar equipment. A flexible-hose suction pipe furnished with the filter is run from the pump connection *A* on the filter to the drain of the oil chamber on the machine, and the clean oil discharge *B*, is carried back to the machine. In this way the oil can be filtered while the machine is in operation.

The filtering medium consists of three filtering bags, shown assembled and disassembled in Fig. 2. The inside bag is made of medium-weight muslin, the center and outside bags are of material of special texture and thickness. Each bag is attached to its respective ring so that it can be readily washed without removing it from the ring. The motor for driving the pump *C* is inclosed within the base of the filter, and the discharge pipe *D* is so arranged that the filtering bags can be removed for washing

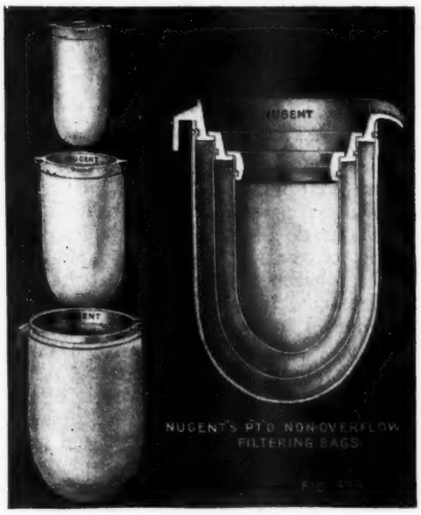


Fig. 2—Filter bags

or exchanging for a new set without disturbing any piping, as indicated in Fig. 1, which shows a filtering bag being removed. By closing the valve *E* and opening the valve *F*, the oil may be refiltered as many times as desired.

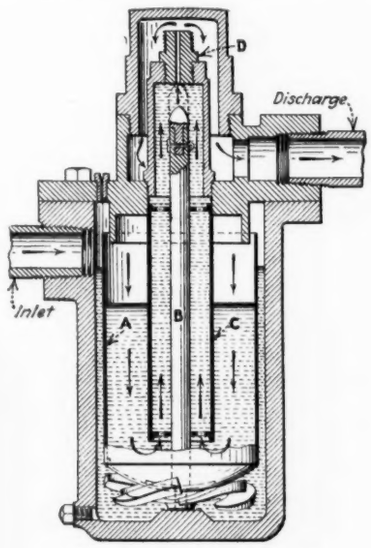
The unit can be supplied with a light angle-iron stand 31 in. high, if desired. This stand is used to elevate the filter, to make it more convenient and to facilitate the flow of oil back to the machine.

The base of the machine is 9½ x 13½ in. over-all, and the total height without the stand is 24 in., and with it, 55 in. A flexible steel suction hose ⅜ in. in diameter and 6½ ft. long, and a discharge hose ½ in. in diameter and 3½ ft. long, are furnished with the filter. The weight of the filter and motor complete is 35 pounds.

Trerice Steam Trap

LARGE capacity with small size and weight are features of the trap brought out by the H. O. Trerice Company, 1338 West Lafayette Boulevard, Detroit, Mich., a cross-section of which is shown herewith.

The trap consists essentially of the bucket *A*, valve spindle *B*, with guiding sleeve *C* and valve seat *D*. In



Cross-section of trap

operation the water enters as indicated by the arrow, raising the level in the trap body until it overflows into the bucket, the bucket meanwhile floating and keeping the valve closed. When the bucket has filled sufficiently to overcome the buoyancy, it sinks, opening the valve wide. The water from the bucket is then discharged up through the guiding sleeve *C* as indicated by the arrows, until the buoyancy will float the bucket and close the valve again.

A small aluminum propeller is attached to the bottom of the bucket to give the bucket and valve spindle *B* a rotating motion as the bucket drops. This tends to clean the seat at each operation and keep the valve tight.

The valve and seat are of chrome nickel, the seat being reversible. It is claimed by the manufacturer that the trap is equally suitable for removing condensation from air lines or discharging oil from separators.

The trap is made in three sizes: No. 2, with ½- and ¾-in. inlet and outlet connections respectively; No. 3, with 1- and 1¼-in. connections, and No. 4, with 1½- and 2-in. connections, and having capacities around 2,400, 7,800 and 14,400 lb. per hour respectively.

Pulverized Coal in

Stationary Railway Power Plants—III

As mentioned in a previous issue, the railway stationary power plants burn nearly half as much coal as all the central stations combined. The number of these plants is large; many are inefficient; and they offer large opportunities for savings through installation of modern equipment and improved operating methods. Their problems are akin to those of many industrial plants. This section of the report on "Coal Fired Plants" by a Subcommittee of the International Railway Fuel Association discusses difficulties with pulverized coal and their avoidance, ash and dust disposal, furnace design and types of burners. Next week will conclude the report with a discussion of the economics.

NO ONE ought to buy pulverized-coal equipment until he has personally seen at least a dozen installations of at least three competitors. Care should be taken that the coals and operating conditions of the plants seen are reasonably close to those anticipated. Care should also be exercised to locate the "common or garden variety" installation and not the especially selected one.

Above all things the prospective buyer should not get so sold on one particular part of a system that he forgets the operation of the system as a whole. A burner may be excellent with one pulverizer and not function at all with another or with a different coal. A given pulverizer piping system and burner may be satisfactory with a solid wall construction, but may be a complete failure on a water-wall furnace with too much cold surface exposed.

One of the most fruitful sources of trouble is usually the operator's own fault. An installation is originally designed for a maximum of 200 per cent of rating. Later, through failure to anticipate requirements properly, the operator tries, say, 220 per cent and finds he can carry it. Next he tries 250 or 275 per cent and quickly gets into a lot of expensive trouble. Ordinarily, it is much cheaper to overestimate rather than underestimate one's requirements.

Deposition of Ash and Coke Dust

The percentage of ash emitted varies with draft and velocity of gases in the furnace, boiler breeching and stack, physical characteristics and quantity of the ash, construction of flues from boiler to stack, type and baffling of boiler, fineness of pulverization and method of firing.

It appears to the committee, from replies received, that on the average half to three-quarters of the ash goes up the stack. A manufacturer of both stokers and powdered coal states, "The ash deposited from pulverized coal has been reported less objectionable than the cinder deposited from stokers."

With over forty-one million coal particles (85 per cent through 200-mesh) to each cubic inch originally and not over 5 to 20 per cent of each particle consisting of ash, it can be appreciated that the size of the individual ash particles must be microscopic, running perhaps more than a hundred million to the (solid) cubic inch.

Dust Precipitators

There are numerous methods of collecting fly-ash and coal dust which have appeared on the market. Three well-known types are mentioned below.

Unquestionably, the most efficient is the electrostatic "Cottrell Precipitator," as installed most successfully at the pulverized-coal installation of the Trenton Channel Plant of the Detroit Edison Company, near one of Detroit's finest suburban residential districts. While the percentage of ash caught is of the order of 95 per cent of the total passing, the cost of such equipment would generally be prohibitive for small plants.

The American Blower Company has installed at the new East River Station of the New York Edison Company, the so-called "Sirocco" collector, consisting essentially of a suction cyclone system. The Green Fuel Economizer Company offers a cinder trap with a series of baffles and dust pockets arranged somewhat like a "steam purifier," providing a tortuous path for the dust-laden gases, which deposit their solid content through changes of direction and velocity. Both these systems claim to separate and deposit 85 to 90 per cent or more of the total entrained ash before it reaches the stack. Both systems are made in sizes small and inexpensive enough to be applied on small installations.

Water washers, though installed at several plants, have not in general proved very satisfactory, as it seems almost impossible to make water spray and powdered coal dust adhere in suspension.

Except in unusual cases such as those mentioned at Detroit and New York (very large plants in the hearts of thickly populated districts), this committee does not recommend as necessary initial installations of dust precipitation equipment. When in doubt, proper space can be left in making up the plant design so that such apparatus can be installed later if operation proves their use unavoidable.

Dust Pockets and Soot Blowing

With 15 to 20 per cent of the total ash deposited in the boiler passes, it is obvious that adequate provision for soot blowing and dust pockets must be made and used, or considerable good heat-absorbing surface may be insulated from hot gas flow and hence wasted. Generally, the suspended matter is easier to blow than sooty smoke from grate fires, but the quantities to be blown are greater. Number and location of soot blowers will generally be substantially the same as with a properly designed stoker or hand-fired job, for if the jets will reach substantially all parts of the boiler, this is the best that can be done in any case. Sometimes, however, a somewhat more frequent blowing schedule proves paying practice with powdered coal.

With the widely variant types and bafflings of commercial boilers there is no substitute for cleverness in design as the solution of proper dust pocket location. As this deposit usually contains most of the unburned carbon carried over (sometimes running more than half carbon) the saving of it often adds one per cent or more to monthly overall operating efficiencies.

Tube Slagging

With low-fusion (2,100 deg. F.) ash coals if the heat release per cubic foot of combustion volume is high (17,500 B.t.u. and over), trouble is sometimes

> He who becomes so sold on powdered coal that he believes the day of the stoker is already past should watch his step. Powdered coal is no panacea, but a prescription which can be woefully and grievously misapplied. This committee expects to see stokers sold for some installations as long as any man on it is alive. Far higher efficiencies are possible with present-day stokers than with those of even five or ten years ago.

encountered with slagging over of the lower row of boiler tubes. Ordinarily, no greater trouble will be encountered than with stokers under the same conditions unless the ratings desired are materially higher. The two best remedies are either dropping alternate boiler tubes in the first row, thus lowering entering velocities and providing a slag screen which cannot bridge over, or providing enough water-wall surface in the furnace to insure freezing of molten slag in suspension before it reaches the boiler tubes.

The fundamental criterion of furnace design should be that the walls be so spaced and designed that destructive wall punishment will not occur through flame impingement (as the molten ash acts as a flux in eroding the brickwork), yet that maximum utilization of available combustion volume shall be effected. In fulfilling this criterion, the B.t.u. per cubic foot of furnace volume means comparatively little and flame lengths much. As the power plant public, however, has grown to think in terms of B.t.u. per cubic foot per hour, the following question was asked the manufacturers: "Under what conditions of ratings, ash fusion, heat release, etc., do you recommend (*a*) solid walls (*b*) air cooled walls (*c*) water, ash or slag screens or water cooled bottoms and (*d*) water walls." Among the variables are:

1. Duration of and rating under peak load.
2. Furnace proportions and shape possible.
3. Radiant-heat absorbing surface and its location with respect to refractory surface.
4. Method of firing—vertical, horizontal or inclined.
5. Type of burner.
6. Minimum rating desired.
7. Coal characteristics and fineness of pulverization.
8. Minimum permissible unburned carbon carry-over and excess air.
9. Maintenance cost limitations.

Based on experience and the general average of the manufacturers' replies, the committee offers the following tabulation of B.t.u. per cubic foot per hour as conservative maximum figures for non-slagging furnaces:

Wall Construction	Ash Fusion: 2,100-Deg. F. and below	2,100-2,400 Deg. F.	2,400-Deg. F. and Above
Solid walls	Never	12,500	15,000
Air-cooled walls	12,000	15,000	7,500
Water-cooled bottoms	16,000	17,500	20,000
Water walls	17,500	22,000	30,000

While there are many instances of designs considerably exceeding these figures, an equal number of attempts to exceed them have resulted in failure. Once the furnace is designed and built, it is most expensive to change. With no two coals just alike, it is better to be safe than sorry.

Flame lengths, are even more important than combustion volumes. With horizontal turbulent mixing burners, not too highly forced, and with ample space laterally to prevent impingement on the side walls, consensus of opinion seems to favor a minimum distance from front to back wall of 14 ft., though two companies claim success with 12 to 13 ft. under favorable conditions. Under special conditions, this minimum may go up as high as 16 ft. For vertical streamflow firing the replies vary from 18 to 23 ft., depending upon the burning characteristics of the coal, incoming jet velocities, air preheat and many other factors. In the relatively few instances where vertical firing is applicable in boilers of the sizes discussed, no mistake will be made in keeping to a conservative minimum of at least 22 ft. from arch to floor or slag screen.

Flame widths will vary more widely between different burners, but from the minimum desirable furnace widths, it would seem that 6 to 9 ft. should be the minimum furnace width possible with any burner. With the turbulent mixing types flame impingement and erosion of the side walls may be expected with many even at greater widths than these.

With inclined firing, flame lengths depend principally on whether fundamentally the firing method is a modification of the vertical or the horizontal method. Very slight inclinations of but a few degrees to the horizontal are usually modifications of horizontally fired systems, hence take minimum horizontal flame lengths. Most burners inclined over 15 to 20 deg. to the horizontal are usually modifications of vertical firing and the 22-ft. minimum flame length previously given, is again recommended.

Solid walls should never be used for high ratings on low-fusion ash coals. The chemical characteristics of such coal ashes are generally basic, while most boiler-furnace refractories are acid. This chemical affinity dooms such installations either to inefficient utilization of available furnace volume or to high maintenance.

Where solid wall constructions are permissible, provision should be made for expansion strains. The life of a setting depends, among other things, on freedom from unrelieved expansion strains, therefore the fire lining should be able

Classification of American Pulverized Coal Burners

- Horizontal
  - Stream Flow
    - Round Opening — "Feeco" (Fuel Eff. Eng. Co.)
    - Oval or Rectangular Slot — Erie "Curtain"; Fuller Fishtail; Unipulvo Fishtail
  - Mixing
    - Staggered Slot Mixing
      - Vertical Axis — "Calumet" (Fuller Lehigh)
      - Horizontal Axis — "Turbex" (Fuel Eff. Eng. Co.); "Zigzag" (Erie); Kennedy Duplex Mixing
    - Centrifugal Mixing
      - Fuel through Center — Bailey-Tenney; Babcock & Wilcox; Couch (Comb. Eng. Co.); Drake (Fur. Engr. Co.); Grindle Carburizer; Riley "Flare Type"
      - Air through Center — "Enco"; Peabody Standard; Peabody "Toronto"; Kennedy Rotary Mixing
      - Fuel and Air together — Unipulvo "Vertex"
- Vertical or Inclined
  - Stream Line
    - Round opening — "Feeco" (Fuel Eff. Eng. Co.); "Pulverburner" (Illinois)
    - Oval or Rectangular Slot — Erie "Curtain"; Fuller Fishtail; Kennedy Fishtail; Unipulvo Fishtail
  - Mixing
    - Staggered Slot — Lopulco "Fantail" (induced draft); Lopulco "Fantail" (forced draft)
- Tangential Firing
  - Vertical Axis — "Steam Generator" (Comb. Eng. Co.); "Well Furnace" (Fuller Lehigh)
  - Inclined Axis — "Well Furnace" (Fuller Lehigh)
  - Horizontal Axis — Drake "Well Type"; Erie "Vortex"; "Well Furnace" (Fuller Lehigh)

to expand independently of the outside walls and the foundations should be kept at or near that of the outside walls or steelwork. Generally, it is poor economy to use red brick instead of No. 2 firebrick for outside walls, as the co-efficient of expansion of the red brick varies radically from that of the No. 1 brick in the fire lining.

Air-Cooled Walls

Air-cooled walls (unless intricate patented constructions are employed) generally cost little if any more than solid walls and are nearly always preferable, assuming no flame impingement except where long valley loads or banking periods make great heat storage desirable. For success in operation and low maintenance, an air-cooled wall construction should comply with the following specifications:

1. Ample provision for expansion, growth or deformation in all directions.
2. Proof against air leaks to furnace.
3. Uniform and continuous air flow without short-circuiting or plugging of air ducts.
4. Simplicity and inexpensiveness both as to material and labor, particularly as to special refractories or shapes used.
5. Easy removal and replacement of section without distrubance of adjacent sections.
6. Tie-in or bonding members should not be exposed to fire nor subjected to unequal expansion.
7. Either the inner refractory lining must be kept thin or be of unusually high heat conductivity (such as silicon carbide).

With these seven factors properly cared for, there is a minimum chance of slagging or spalling. However, such furnaces should not be subjected to too widely variant load conditions nor be cooled off too quickly after shutting down. Care must be exercised that "side-wash" of the flame from the burners does not permit flame impingement and the burning of holes in the walls through erosion.

Water Walls and Bottoms

Air-cooled walls in combination with ash, slag or water screens or water-cooled furnace bottoms offer a convenient expedient for inexpensively obtaining a source of hot air for the mill to aid in drying the coal. The life of such constructions can never be expected to be comparable with water walls. These latter, however, in the present market average from $18 to $30 per square foot of furnace area, hence are just about as much more expensive as their relative life and maintenance.

On any water-wall or water-screen job care must be taken that good feed water is available, for on bare tube structures tube failures with high heat releases have been reported even in plants having evaporated boiler feed, though such cases are, of course, unusual. No maximum concentration can be specified for this is dependent upon:

1. The regularity of the load.
2. The per cent of rating.
3. The character of the impurities in the feed water.
4. The amount and character of oil in feed water.
5. The attention given the treatment.
6. Completeness of chemical reactions in the softener.
7. Size of softener.
8. Regularity of proportioning of feed water with load.
9. Uniformity in feed-water temperature.

Water-wall surface will, of course, markedly increase boiler capacity, for from two to six times as much heat is generally absorbed per square foot as in the same average water surface in the boiler. However, water walls should be installed for the above reason as well as to decrease furnace maintenance and increase reliability. They should not be installed in the hope of increasing overall boiler and furnace efficiency. Ordinarily, a square foot of surface added to the boiler will increase the efficiency just as much as a square foot added in the water walls, but the former costs but one-tenth of the latter initially.

Other Radiant-Heat Absorption Surface

In a long bent-tube boiler with refractory walls, there is much less chance of high wall maintenance than in the usual horizontal straight tube. Similarly, with a narrow vertically fired furnace the chance of expensive wall punishment is greater than with a reasonably wide one. In general, it may be said that failure to expose maximum tube or shell surface to the furnace leads to high furnace temperatures and limited capacities with refractory covered walls.

It may be appropriate at this point to state to h.r.t. users contemplating pulverized fuel that much trouble will be saved by insisting in the original design that blowoff connections be properly protected from the heat of the flame. They should be located where possible at the extreme front of such boilers and outside the furnace itself when possible. If already located in the rear on existing installations, either a constant circulation to a higher water level in the boiler or a water-cooled sleeve should be provided to protect the blowoff pipe from the hot gases.

Secondary Air

When admitted to the furnace, gravity pulls cold air down. Thus, secondary air inlets should not be placed underneath horizontal burners. Induced secondary air pulled into openings in the side walls should not be expected to produce turbulence in a flame stream traveling a mile a minute alongside. Vertically fired furnaces usually have a distinct chimney effect in the furnace, which in some cases results in positive pressure at the top of the furnace making induced secondary air admission around the burner often impossible in such cases. This necessitates admitting secondary air at the bottom and results in long flame and delayed combustion. Care must also be exercised in such furnaces to prevent short circuiting of unburned primary air and fuel from the near side of the burner to the first pass of the boiler.

Ash Removal

Though only 10 to 25 per cent of the ash contained in the coal is precipitated in the furnace, this amount must not be forgotten. If the rules previously given are observed, the ash which deposits in the furnace bottom will be in solid form. Proper ash disposition contemplates keeping it that way and utilizing a minimum of labor or equipment for its removal. If allowed to accumulate or pile up, its high thermal resistive capacity may soon cause it to begin to slag up over its upper surface. This slag may subsequently permeate the accumulation, making it difficult to dig out, even though water walls or bottoms are employed. With the lowest ash fusions and relatively high heat releases this may demand pulling ashes once each shift, although this is seldom the case. Ash removals only once or twice weekly are not uncommon even with low-fusion ash coals of reasonably low ash content.

Steam or air jet systems usually lend themselves well to the light flocculent ash deposited. Water spray is absorbed very slowly so that car loading is usually a dusty operation. No use has yet been found for powdered coal ash, as it is usually so light it makes poor fills.

Generally, a maximum possible slope consistent with economy of available space is desirable on the furnace bottom which serves as an ash accumulating hopper. Though flat bottoms are sometimes the only alternative, bottoms inclined 45 deg. or more are preferable when possible.

Direction of Firing

Usually, an inherently long flame should traverse the long axis of the furnace. A narrow furnace should have a narrow flame. A short wide furnace should have a short wide flame. In general, the shorter the flame the better, if the shortening process does not involve flame impingement on the front or side walls. At the same time full advantage should be taken of the available space to make the furnace as large as economically possible without providing dead gas spaces.

Rear-end firing of bent-tube boilers is becoming increasingly popular. It makes possible a fully water-cooled front wall, whereas with front-end firing a similar attempt to water cool generally represents prohibitive expense, as water-wall headers are the most expensive part of the construction. Unless long tube lengths can be used, the wall cost per square foot hardly justifies the investment.

Burners and Turbulence

Many so-called turbulent burners waste fan energy stirring up the mixture prior to ignition with little thought of what happened during the 90 per cent of the flame travel which occurred thereafter when this initial turbulence was quenched. Effective turbulence (prin-

cipally after ignition) is vitally necessary.

Some of these "turbulent" burners actually harm rather than help an installation. It is easy to expedite ignition to such point as to slag the front wall seriously. Many widen out the normal flame cone until side-wall impingement causes erosion. The range of flexibility of many of these burners is often far less than is needed for the operation or than would otherwise be possible without them. As the number of burner sizes manufactured by any one manufacturer is usually limited, it often occurs that the burner and pulverizer maximum and minimum ratings do not correspond, thus further limiting the flexibility of the system. On burners the committee's advice is, "Be sure you're right, then go slow and think it over."

Much lower powdered-coal jet speeds at the tip of the burner are desirable than are necessary to keep the dust in suspension in the fuel pipe. This slowing down is generally accomplished by widening out and flattening the burner just before the tip. Though with very fine grinding, powdered coal can be kept in suspension at speeds somewhat less than 2,000 ft. per min., it is not safe to count on less than this as a minimum unless quite certain of one's ground. Velocities can, of course, be increased indefinitely, always, however, at the expense of increased fan power and frequently at the expense of coarse coal and high unburned combustible loss. In general, the lower the air velocity through the mill the finer the grind. If proper minimum limits of velocities and effective piping designs are not observed, the pulverized coal will oftentimes intermittently drop out of the air stream, forming drifts in the bottom of the fuel pipe, which later move to the burner in slugs. This sometimes extinguishes the fire and always introduces large losses and causes smoky fires. For this same reason dampers or valves as attempts to secure greater transport flexibility are generally doubtful and sometimes dangerous expedients, particularly if the dust is allowed to build up in pockets alongside or just behind such valves or dampers and go into a hot furnace in a slug.

The difficulty of maintaining uniform proportioning of coal and air over a wide range of capacity is largely a problem of mill and fan design. It is however, also influenced by changes in the moisture content of the coal, which cuts down mill grinding capacity, yet leaves air quantities the same by reason of the constant-speed fan.

Fuel-Pipe Design

Fuel-pipe diameters are usually based on minimum velocities which will carry the pulverent material in suspension and primary air ratios, as pointed out in the last section. Fuel-piping material is generally light-gage galvanized iron, and with ordinary bituminous coal this is satisfactory for the purpose. With anthracite or bituminous of unusually abrasive character it may be necessary to use heavier material or possibly replaceable liners or bends. Bends must be of large radius, preferably of not less than five pipe diameters, and in each case the maximum radius permissible by the surrounding circumstances should be employed. The only exception to this is where a pipe is run upward and then reversed to bring it down to the burner, in which case a smaller radius is desirable to reduce the approach of a flat place at the bottom of the bend. Pipes should be run in a horizontal direction for very short distances only.

Where necessary (as it usually is) for securing proper flame distribution and utilization of furnace volume without impingement, to divide powdered coal and air streams, it is generally found most difficult to make the division uniformly and continuously into more than two streams at the same point. Dampers and deflectors in the fuel pipe generally do more harm than good.

The method most generally employed where more than two burners are to be fed is to split the discharge line in two from the mill and then at proper distances again split these lines in two. This takes up considerable room and hardly lends itself to more than four burners, which usually, however, is sufficient. Where the pipes are thus divided, the angle which the two branches make with each other should not be over 90 deg. maximum and preferably not over 60 degrees.

Recent Publications

Materials and Design in Turbo-Generator Plant. By O. Lasche. The third enlarged and rewritten edition by Walter Kieser, Departmental Manager of the A. E. G. Turbine Works, translated into English by A. L. Mellanby, Professor at the Royal Technical College, Glasgow, and W. Roylands Cooper. Published by Oliver & Boyd, Edinburgh, 1927. Cloth; 8x10 in.; 204 pp.; extensively illustrated. Price, 24 shillings.

THE availability of this excellent discussion of an important subject to English speaking readers is a valuable addition to the literature of engineering. The discussion covers the characteristics of various metals at elevated temperatures and the determination of their suitability by appropriate laboratory tests, particularly the noticed bar test. Considerable space is devoted to turbine blading, with detailed particulars and the discussion of difficulties arising from vibration and corrosion. The design and testing of rotors for both turbines and generators is described, and chapters are devoted to the corrosion of condenser tubes with excellent colored photomicrographic illustrations, and to turbine bearings. The volume presents extensive experimental data and operating experience on all subjects, and should prove invaluable not only to designers, but also to operators of steam turbines.

Energiespeicherung. Von Dr. Ing. W. Pauer. Band VI, Wärmelehre und Wärmewirtshaft in Einzeldarstellung. Published by Theodore Steinkopff, Dresden, Germany, 1928. 176 pages. Price, 13½ Rm. ($0.25.)

THIS work is a technical treatise on energy accumulation and accumulators. It covers the general theory and such accumulating devices as flywheels, hydraulic pressure accumulators, liquid heat accumulators, steam accumulators and heat accumulation in solid bodies such as regenerators. The treatment is mathematical, but the copious use of curves and diagrams renders it more easy of application. With the growing use of accumulators, particularly for steam, the work should prove useful to American engineers who read technical German. The diagrammatic layouts of typical accumulator applications, showing the correct relations of all the elements in the system, will be of primary service to many power engineers.

Patent Essentials. By John F. Robb, of the Cleveland and District of Columbia Bar. Published by Funk & Wagnalls Company, New York, 1928. Buckram; 6x9 in.; 446 pp. Price, $5.

THIS is a new and revised edition of a well-known standard work on the subject. It includes the 1927 revisions of the patent laws and brings the law of employer-employee right up to date. It discusses the drawing of patent claims and the law of patents exhaustively, with numerous illustrations from court records. The discussions are couched in as nearly non-technical language as possible, and the book should prove of great service not only to lawyers with but few patent cases, but to engineers and laymen generally.

Report for the Business Year 1926-1927, of the Association of Prussian Boiler Users Clubs. Published by the Association, Halle a.d.S., Germany; 280 pages. These proceedings contain many short articles and statistical tables dealing with Germany boiler operating practice and similar topics. For the reader of German, who is also engaged in boiler operation, much will be found in the work that is illuminating as to current European engineering. Non-readers of that language will find the book hard to translate or follow, as are most German technical works. It is to be hoped that the valuable points in this report and other foreign technical works will quickly find the light in English, for the benefit of American engineers.

NEWS OF THE FIELD

The editors will welcome the co-operation of readers in reporting interesting happenings, personal or otherwise

New York's Largest Hotel to Generate Power and Burn Pulverized Fuel

Forty-four story "New Yorker" now under construction will install four boilers with unit pulverizers and 2,200 kw. of generating capacity

NEW YORK'S latest and largest hotel will generate its own power and install pulverized-fuel-fired boilers.

The 44-story "New Yorker" now under construction on Eighth Avenue between 34th and 35th Streets, New York City, will have four boilers fired by unit pulverizers. Four uniflow engine sets with a total generating capacity of 2,200 kw. will be installed to supply the power for all the services in the building.

Four 6,300-sq.ft. cross-drum boilers will supply steam at 175 lb. pressure and 100 deg. superheat. Three 600-kw. and one 400-kw. uniflow-engine-driven direct-current units will comprise the generating equipment. All the main auxiliaries will be steam and motor driven, the motor-driven units being kept normally in service and the steam unit serving as a stand-by and for service as the occasion demands to give the proper heat balance on the plant.

Boilers Will Be Horizontally Fired

Each boiler will be horizontally fired with a single turbulent-type burner. The combustion chambers will be approximately 12 ft. 9 in. wide, 20 ft. long and 20 ft. high, giving a combustion volume of 4,900 cu.ft. or a ratio of combustion volume to heating surface of approximately 0.80. The walls of the furnace will be of air-cooled construction. The boilers will operate normally around 200 per cent of rating, but will be capable of going to 250 or 300 per cent if occasion demands.

One pulverizer of the unit impact type will be installed per boiler, and as three boilers will be sufficient to operate the plant at maximum load, one boiler and pulverizer will constitute the spare equipment.

Each pulverizer will be driven by a direct-current adjustable-speed motor and will have an extended shaft for coupling to a steam turbine to give a dual drive if this should be found desirable later.

An innovation in the arrangement of boiler and pulverizer will be made in that the unit pulverizers will be in a separate room, partitioned off from the boiler room proper; only a short section of the coal and air pipes leading from the pulverizers to the burners will be visible in the boiler room.

Each boiler will have a separate operating board with a full complement of instruments for the proper control of the combustion. In addition there will be a master board to control any one of the four boilers independently, or two or more in multiple.

A vacuum-type ash-conveyor system will be used to carry the ashes from the bottom of the combustion chamber of each boiler to an ash hopper located at about the third-floor level with a discharge pipe leading to a trap door in the ceiling of the driveway.

The 8-ft. diameter stack will pass up through the center of the building and have a total height of approximately 550 ft. The boiler will connect with the stack through an underground breeching and a cinder catcher will be placed in the breeching directly at the turn into the stack.

Heating will be effected by a vacuum return line system having a total of 115,000 sq.ft. of radiation. The system will be laid out on the up-and-down-feed principle. The main distribution point will be on the 24th floor through a 20-in. main. From this floor the steam will be distributed upward to all the floors above and down to the fifth floor. The up-feed system will be through an 8-in. main feeding all floors up to and including the fourth.

The 2,506 room New Yorker will use about eight million kilowatt-hours yearly

Large Refrigerating Capacity

For ventilation large quantities of air will be supplied. This air will be washed and moistened with close regulation of temperature and humidity. During the summer months the air will be cooled by refrigeration. A total of 400,000 cu.ft. per min. of fresh air will be supplied to the building by a number of fans, each equipped with tempering and reheating coils. Sufficient fan capacity to exhaust 600,300 cu.ft. will also be provided.

A refrigerating plant of 240 tons capacity will be installed, consisting of two 120-ton units, one being motor driven and the other steam driven. One 100-ton machine for air cooling and one 15-ton machine for ice making, will be included.

According to the engineer the plant will be as simple as possible consistent with economical operation. All the measuring and recording devices necessary for a complete checking and recording of the plant's operation will be included. It is proposed to make the power plant one of the show places of the building. The engine, boiler and refrigerating rooms will have white tile walls and red quarry tile floors. Special attention will also be given to the lighting and ventilation of the plant.

Sugarman & Berger, 345 Madison Ave., New York City, are the architects for the entire project, and W. E. Cameron, their chief mechanical engineer, is responsible for the design of the plant.

Boiler Manufacturers Combine Business and Pleasure at Annual Meeting At Shawnee-on-Delaware

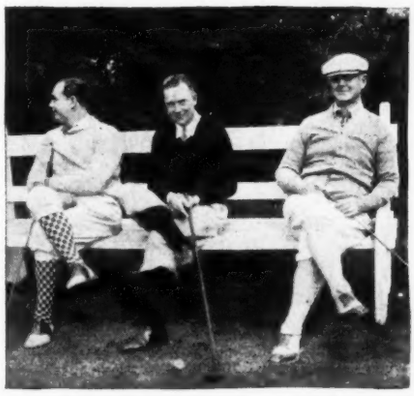
THE American Boiler Manufacturers' Association held its fortieth annual convention, June 11 to 13, at the Buckwood Inn, Shawnee-On-Delaware, with about sixty members and associates in attendance.

At the opening session on Monday, President Barnum reviewed the various factors that have led to over-capacity and duplication of effort, with resulting low prices and small profits in the industry. He urged as remedial measures, a definite program of trade extension, closer co-operation among boiler builders, and closer co-operation with the Department of Commerce.

Various committee reports were presented. That on "Boiler Code Committee Work," read by E. R. Fish, discussed the procedure for incorporating revisions in the A.S.M.E. Boiler Code, and through the National Board of Boiler & Pressure Vessel Inspectors, to make such revisions, mandatory without working a hardship on the boiler manufacturer.

Perry Cassidy, chairman of the manufacturers' Committee, acting with the A.S.M.E. Boiler Code Committee advised that the committee has about completed revisions to the paragraphs of the Code dealing with the design of dished heads.

C. O. Meyers, representing the National Board, discussed the matter of stamping repaired drums. He offered the following suggestions to govern



E. B. Wickes, F. P. Champion, M. J. Tudor

different conditions under which repaired drums are furnished.

1. When the original boiler was not constructed in accordance with the A.S.M.E. Code, the repair drum shall be constructed in accordance with the A.S.M.E. Code and inspected during construction by a qualified inspector, and stamped with the A.S.M.E. symbol, the manufacturer's serial or A.S.M.E. number.

2. When repair drum is to be furnished for a boiler that has been constructed in accordance with the A.S.M.E. Code and original boiler is stamped with the A.S.M.E. number, and not stamped in addition to this with a state standard or National Board stamping, the repair drums shall be stamped in the same manner as the original boiler.

3. When the repair drum is furnished for a boiler that is stamped National Board, the repair drum shall be stamped National Board and carry the same National Board number that the original boiler was stamped with.

4. Repair drums shall be stamped immediately above the State, National Board or A.S.M.E. stamping with the words "Repair Drum." When repair drums are furnished for boilers in Code states a manufacturer's data report shall be filled with the secretary-treasurer of the National Board, in duplicate. One copy of this data will

Charles E. Gorton, G. F. Felker, F. R. Low

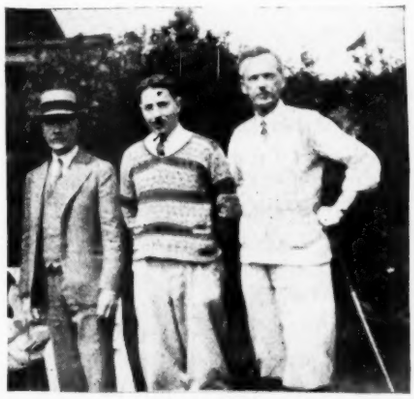
be filed with the proper State department.

Among other recommendations of the National Board was that boilers be stamped upon completion with the year built. Mr. Meyers reported further that the State of Michigan has recently agreed to accept boilers stamped by the National Board and inspected by inspectors holding National Board commissions. At the Tuesday morning session S. F. Jeter referred to the growing number of boiler failures, other than explosions, among large boilers and urged that boiler insurance companies carefully consider the extension of boiler coverage to meet such difficulties, the premium being adjusted accordingly.

G. W. Bach pointed out the lack of uniformity among smoke inspection departments of the various cities as to required heights of settings, length of dutch ovens, etc. Not only is there a lack of uniformity, but requirements change in certain cities with changes in administration. This naturally works a hardship on the manufacturers. A committee of the Boiler Manufacturers Association is now working with the Smoke Prevention Association, with a view to establishing some definite recommendations.

In reporting for the Committee on Boiler Performance Guarantees, E. R. Fish offered the following guide for the working of performance guarantees, as regards the boiler only:

1. That the stoker (or other combustion apparatus) and furnace as installed, shall be capable of burning sufficient fuel to enable the desired



E. R. Fish, A. G. Goldie, A. R. Goldie

capacities to be developed and will maintain conditions not less favorable than those indicated in (7) and (8).

2. That the draft supplied shall be ample to remove the products of combustion and be such as to cause a suction in all portions of the boiler setting at whatever capacity the boiler may be operated.

3. That combustion will be completed in the furnace to the extent that there shall be no smoke darker than No. 1 Ringleman chart and that the average CO in the gases will not exceed 0.1 per cent or the CO_2 vary more than one point from the average. The gases shall be sampled uniformly across the width of the boiler after having passed over the first 20 per cent of the boiler heating surface or at the top of the first pass. There shall be no delayed combustion present at this point or at any point beyond.

4. That baffles and brickwork shall be in first-class condition, that the boiler and superheater shall be clean inside and out, and that they shall be properly operated in all respects.

5. That the measure of performance of the equipment shall be based upon observations made in accordance with the latest Power Test Code of the A.S.M.E.

6. That the following tolerances will be allowed:

Efficiency (if required of boiler manufacturer)..	minus 1 point.
Exit flue gas temperature	plus 5 per cent.
Superheat	plus or minus 10 deg.
Draft loss	plus 10 per cent.

Pressure drop
through superheater ..... plus 10 per cent.
Quality of steam.. minus 2 points.
(Or other values that may be agreed on.)

7. That the fuel shall have an analysis not less favorable than:

Here give analysis of the fuel, including the heating value and B.t.u.

8. That the following conditions shall be not less favorable than:

CO_2 ..... per cent.
Total unburned carbon, per cent of fuel (if boiler efficiency is required).
Radiation and unaccounted, per cent of total B.t.u. (if boiler efficiency is required).

Then, on the basis of the foregoing, the expected performance figures or guarantees, when making . . . pounds of steam per hour, will be:

Efficiency (if required of boiler manufacturer) ..... per cent.
Exit flue gas temperature .... degrees.
Superheat ..... degrees.
Draft loss through boiler..... inches.
Pressure drop through superheater ..... pounds.
Quality of steam ..... per cent.

As in previous years the afternoons were devoted to golf and on Tuesday evening there was a banquet.

The following were elected officers for the ensuing year: President, H. E. Aldrich, Wickes Boiler Company, Saginaw, Mich.; Vice-President, Charles E. Tudor, Tudor Boiler Mfg. Company, Cincinnati, Ohio. Executive Committee: Starr Barnum, The Bigelow Company, New Haven, Conn.; Geo. W. Bach, Union Iron Works, Erie, Pa.; C. W. Edgerton, Coatesville Boiler Company, Coatesville, Pa.; Owsley Brown, Springfield Boiler Company, Springfield, Ill.; J. R. Collett, Pacific Steel Boiler Corporation, Waukegan, Ill.; E. R. Fish, Heine Boiler Company, St. Louis, Mo.; S. G. Bradford, Edge Moor Iron Company, Edge Moor, Del.; A. G. Pratt, Babcock & Wilcox Company, New York; A. C. Weigel, Walsh & Weidner Boiler Company, New York. C. W. Baker was reelected Secretary and Treasurer.

A.S.M.E. Announces Program for Second National Fuel Meeting at Cleveland

Under the auspices of the Cleveland Section of the A.S.M.E., the second national fuel meeting is scheduled to convene Sept. 17 to 20 at Cleveland, Ohio. The Program Committee is already in the enviable position of being able to announce a preliminary program that bears a remarkably close resemblance to a completed task. The executive committee of the fuels division under the chairmanship of Victor J. Azbe, and the local general arrangements committee, under the chairmanship of E. H. Whitlock, are in charge of the technical program and entertainment events. There seems to be little doubt that, in subject matter at least, the following list of papers will make up the final program for the meeting now three months hence:

General

Opening address, Thomas T. Baker, president, Carnegie Inst. of Tech., Pittsburgh, Pa.; "Present Tendency of Boiler-Water Conditioning," R. E. Hall, Hall Laboratories, Pittsburgh, Pa.; "Possible Avenues of Productive Research on Coals," F. R. Wadleigh, Consulting Engineer, New York, N. Y.; "Progress Toward Direct Firing of Boilers with Producer Gas," W. B. Chapman, Consulting Engineer, New York, N. Y.; "Washing and Preparation of Coal," H. D. Smith, assistant to president, Majestic Collieries Co., Bluefield, W. Va.

Fuel Characteristics

"Relative Values of Solid, Liquid, and Gaseous Fuels," T. Ward, Mass. Inst. of Tech., Boston, Mass.; "Constitution and Classification of Coal," A. C. Fieldner, Ch. Engr., Exp. Sta. Div., U. S. Bureau of Mines, Washington, D. C.; "Fuels and Their Flame Characteristics with Reference to Combustion Values and Furnace-Space Requirements," Henry Kreisinger, Research Engr., Combustion Engrg. Corporation, New York, N. Y.

Industrial

"Industrial-Furnace Efficiency Economic Considerations," Jas. H. Herron, Cleveland, Ohio; "The Use of Fuels in Tunnel Kilns," W. E. Rice, U. S. Bureau of Mines, Pittsburgh, Pa.

Marine

"Pulverized Coal Firing of Marine Boilers." "Stoker Firing of Marine Boilers." "Oil Firing of Marine Boilers."

Power Plant

"Recent Developments and Improvements in the Baffling of Vertical Boilers," A. O. Danks, Cleveland, Ohio; "Texas Lignite as Fuel for Power-Plant Boilers," Hal C. Weaver, Prof. M.E., Univ. of Texas, Austin, Texas; "Stoker Advantages and Difficulties," Theo. Maynz, Cons. Engr., Cleveland, Ohio; "Developments in Recent Design of Stoker-Fired Equipment," Jos. G. Worker, Asst. to Pres., American Engrg. Co., Philadelphia, Pa.; "Boiler-Furnace Refractories," C. F. Hirshfeld, Research Dept., and W. A. Carter, Tech. Engr., Power Plants, Detroit Edison Co., Detroit, Mich.; "Determination of Economic Value in the Selection of Power-Plant Equipment," F. M. Van Deventer, M.E., Constr. Dept., Henry L. Doherty & Company, New York, N. Y.

Pulverized Fuel

"Progress in Central-Station Use of Pulverized Coal," Edw. H. Tenney, Chief Engr., Power Plant, Union Elec. Light & Power Co., St. Louis, Mo.; "Present Status of Furnace and Burner Design as Affected by the Use of Pulverized Fuel," E. G. Bailey, Pres., Fuller-Lehigh Co., Fullerton, Pa.; "The Present State of the Art of Collecting Dust from Chimney Gases in Powdered-Fuel Installations," Kurt Toensfeldt, Research Engr., Combustion Engrg. Co., New York, N. Y.; "Unit System of Coal Pulverizers," John Blizard, Head, Research Dept., Foster Wheeler Corporation, New York.

Railroad

"Railway Practices in Utilization and Conservation of Oil," J. M. Clark, Chief Fuel Supervisor, So. Pac. R.R. Company, San Francisco, Calif.; "Relative Values of Different Sizes of Same Fuel in Locomotive Service," John J. Crawford, Fuel Engr., C., B. & Q. R.R. Co., Chicago, Ill.; "Selection and Use of Fuels in Locomotive Practice," Malcolm McFarlane, N.Y. Central R.R. Co., New York; "Railway Practices in Utilization and Conservation of Coal," W. J. Overmire, Fuel Engineer, Big Four R.R. Co., Indianapolis, Ind.

Smoke Abatement

"The Measurement of Atmospheric Smoke Pollutions," A. S. Langsdorf, Acting Dean Engrg., Wash. Univ., St. Louis, Mo.; "Smokeless and Efficient Firing of Domestic Furnaces," Part II, Victor J. Azbe, Consulting Engineer, St. Louis, Mo.; "Problems and Methods in Smoke-Abatement Work," H. K. Kugel, Deputy Smoke Commissioner, Cleveland, Ohio; "Damage Due to Smoke and Smoke-Abatement Methods," H. B. Meller, Commissioner of Smoke Inspection, Pittsburgh, Pa., and Director, Smoke-Abatement Research, Mellon Institute of Tech.

Two Well-Known Boiler Manufacturers Merge

An important announcement in the boiler field is the consolidation of the two old and well-known firms of Walsh & Weidner and Casey-Hedges. These firms, both located in Chattanooga, Tenn., have a combined record covering more than eighty years and will carry on under the new name of The Hedges-Walsh-Weidner Company. The proximity of the two plants will permit better use of the facilities and eliminate duplication.

The management of the new company will have the following directors: M. M. Hedges, L. R. MacGowen, A. C. Weigil, C. P. Llewellyn, Thomas R. Johnson, S. H. Daniels, George T. Smith, James Hedges and Alfred Hill.

Second Paugan Falls Unit Goes Into Operation

At the Paugan Falls plant of the Gatineau Power Company, on the Gatineau River, in the province of Quebec, the second of six 34,000-hp. units was recently put into operation. Of the 204,000 hp. to be generated at the Paugan Falls plant, 68,000 hp. is now available for the Gatineau Power Company's requirements. Work on the other four units is proceeding, and each unit will be turned over as it is made ready.

Tide-Water Power Station Planned for Britain

The establishment of a big hydro-electric power plant at the Wash, in Lincolnshire, England, is planned by the Dynamic Electrical Company. According to the project the Wash area of about 158 square miles would be divided into a full basin of 100 square miles and an empty basin of 58 square miles. Two dams are to be constructed —a sea dam with inflow sluice gates to allow the high tide to flow into the basin at or near high-tide level and with locks to permit the passage of shipping, and a dividing wall to separate the full from the empty basin. Upon the dividing dam the power station is to be erected, so that the water would fall fifteen feet through turbines from the higher to the lower level. The sea dam between the lower level and the sea would have outflow sluice gates, through which the waste water from the power station would return to the sea at low-water level, thus providing a continuous supply of power at full and at low tide levels. The sea dam is to be about 12½ miles in length, and the dividing dam about 13 miles. It is claimed that there are no engineering difficulties, and it is estimated that the total cost of the project would not exceed $35,000,000.

Pennsylvania "U" Will Again Give Course in Fuels

The Towne Scientific School of the University of Pennsylvania announced that beginning Oct. 1, 1928, it will again give the one-year course in fuel engineering that was given for the first time during the school year now ending. The details of this course, leading to a degree of master of science in fuel engineering, are given in a bulletin published by the university. This practical course embraces a study of fuel resources, mining methods, composition and combustion of fuels, manufacture of special fuels, use and specifications for purchase, furnaces, sampling, analysis and calorimetry, fuel testing in heating and power appliances, and regulations affecting use of water power and fuel resources. Many lectures on these subjects are scheduled by national authorities.

Power Engineers Meet In Syracuse

The thirty-third annual convention of the New York State Association of the National Association of Power Engineers was held in the Onondaga Hotel, Syracuse, N. Y., June 7-9. A complete program was provided, and the discussions covered many problems of the power engineers. George W. Diebold, head of the state group, presided as chairman. Among the subjects discussed were: "Illumination," by C. M. Snyder, illuminating engineer of the General Electric Company; "Furnaces and Stokers," by C. H. Brunner, sales engineer of the Westinghouse Electric & Manufacturing Company; Rich D. Whitney, engineer of the Atmospheric Nitrogen Company gave an educational talk. The grand ballroom of the hotel was filled with exhibits of tools and power accessories.

The honor guest of the convention was Elmer S. Basset, of Hartford, Conn., president of the National Association. Mr. Basset gave an interesting talk to the delegates at the final dinner, commending the New York State group on its activities during the last year.

The final business meeting was held Saturday afternoon. Among the resolutions adopted was one relating to the licensing of power engineers in New York State to protect against boiler explosions and other dangers connected with the operation of power plants. A committee was appointed to work for the passage of a state license law at the next sessions of the legislature. The committee will carry on an educational program to inform the public of the necessity of this legislation. George M. Diebold, of Buffalo, was indorsed for nomination to the national presidency. The delegates visited the plant of Brown-Lipe-Chapin Company and made a trip by bus to Tully. Entertainment and side trips were provided for the ladies. Buffalo will be the next convention city.

Coming Conventions

American Institute of Electrical Engineers, annual Summer convention at Denver, Colo., June 25-29; F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Society of Heating and Ventilating Engineers, Summer meeting at West Baden Springs Hotel, West Baden, Ind., June 26-29; A. V. Hutchinson, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers, Twin-City regional meeting at St. Paul, Aug. 27-30; Boston regional meeting, Oct. 1-3; second national fuels meeting at Cleveland, Ohio, Sept. 17-20; Calvin Rice, secretary, 29 West 39th St., New York City.

American Society for Testing Materials, Atlantic City, June 25-29.

Association of Iron and Steel Electrical Engineers, annual convention and Iron and Steel Exposition at Hotel Stevens, Chicago, June 25-29.

Canadian Steel and Power Show at the University of Toronto Arena, Sept. 4-7; Campbell Bradshaw, secretary, 24 Front St., West Toronto, Canada.

National Association of Power Engineers, annual convention at Detroit, Sept. 11-15, and concurrently National Exhibitors' Assn. exhibit; Fred Raven, 417 South Dearborn St., Chicago. New England States Association convention at Hartford, Conn., June 21-23; K. W. Lundberg, secretary. Foot Guard Armory, Hartford.

National Board of Boiler and Pressure Vessel Inspectors, meeting at Erie, Pa., June 18-20.

National Association Practical Refrigerating Engineers, annual convention at Louisville, Kentucky, Nov. 20-23; E. H. Fox, secretary, 5707 West Lake St., Chicago, Ill.

Stoker Manufacturers Association, fall meeting at Greenbrier Hotel, White Sulphur Springs, W. Va., Oct. 22-24.

Second Bituminous Coal Conference will be held at Pittsburgh, Nov. 19-22.

Universal Craftsmen Council of Engineers, Newark, N. J., Aug. 7-10.

World Power Fuel Conference at the Imperial Institute, London, Sept. 24 to Oct. 6.

Man-Made Lightning to Be Produced at Leland Stanford University

Artificial lightning flashes at a potential of 1,500,000 volts, produced by an impulse generator of the type first developed by F. W. Peek, of the General Electric Company, several years ago, will soon be available in the Harris J. Ryan high-voltage laboratory of Leland Stanford, Jr., University at Palo Alto, California. The generator, which is an arrangement of capacitor and resistor units, will be the first high-voltage unit to employ cable-type capacitors in place of the glass plate-type formerly used in these generators. It will be connected to the 2,000,000-volt 60-cycle testing set put into operation in the Stanford laboratory about a year ago. The impulse voltages produced by the generator will be used in studies of high-tension transmission systems and the lightning protection problems with which they are faced.

The new impulse generator was designed and manufactured by the General Electric Company at its Pittsfield plant and is at present undergoing tests at the company's high-voltage laboratory there. The apparatus consists of six cable-type capacitors of new design, and two banks of water-tube resistors, and will be so arranged in the university laboratory that several combinations of capacities can be obtained.

The high voltage laboratory at Stanford University was completed in 1926 and is under the direction of Prof. Harris J. Ryan, head of the electrical engineering department there, and past-president of the A.I.E.E. Professor Ryan is now devoting all his time to research and engineering work in this laboratory, in connection with problems of design and operation which are presented by the extensive high-voltage transmission network reaching from Seattle to San Diego.

The laboratory was made possible through the co-operation of the electric power companies on the West Coast, in recognition of the technical assistance which the laboratory will furnish them in the future. Professor Ryan is considered one of the foremost authorities in the country on high-voltage transmission problems and has for many years acted in a consulting capacity for the western power companies. He has made important contributions to the solution of the engineering difficulties met with in the construction of the high-voltage network which interconnects Pacific Coast cities over a distance of more than 1,000 miles.

OBITUARY

CHARLES PALMER MCMULLEN, prominent inventor of engineering devices and for years connected with the United States Shipping Board of New York, passed away at his home in Lyndhurst, N. J., on June 3, after a week's illness following a paralytic stroke. He was born in Bordentown in November, 1854. During the Spanish-American War he was chief engineer of the U. S. Army transport, "McClellan." In the World War he was assistant superintendent of transport service at Hoboken. His civil employ was as marine and mechanical engineer. At the time of his death he was assistant port engineer for the U. S. Shipping Board of New York. Probably the thing for which Mr. McMullen is most noted is the invention of the Ideal automatic pump governor. He also invented many other engineering devices.

CHARLES C. ELY, president and treasurer of the Trimont Manufacturing Company, Inc., Boston, Mass., widely known throughout the mechanical trade, died on June 7. Mr. Ely came to Boston in 1902 upon the death of his brother, who had organized the Trimont Manufacturing Company in 1888. Upon taking up his duties, he became president and treasurer, which offices he held continuously until his death. His favorite philanthropies were with institutions devoted to the advancement of youth, and he was known as a liberal contributor to such organizations as the Roxbury Latin School and the Roxbury Boys' Club.

PERSONALS

DR. H. C. PARMELEE, editor of *Chemical & Metallurgical Engineering*, has just returned from a trip to Europe, where he studied the chemical industry, particularly from the angle of new industrial cartels in Europe and their possible effect upon the chemical industry in the United States. He reports that the chemical industries of England and Germany are in excellent condition and seem to be sharing more fully than other industries in the general economic recovery. They have ample financial resources, excellent technical direction and business management, and are expanding their participation in world trade.

ALEX DOW, president of the American Society of Mechanical Engineers, recently sailed for a six weeks' trip abroad.

H. H. BARNES, JR., has been appointed manager of the New York district of the General Electric Company, to succeed Theodore Beran, who recently retired.

F. B. HOFF of the Allen-Sherman-Hoff Company, is in Europe on a business trip and expects to return some time in July.

PAUL E. SHACKLETT, for the last ten years power sales manager in Chattanooga for the Tennessee Electric Power Company, has been appointed assistant manager of the Chattanooga district of the company. W. G. Davies, Jr., has been appointed to succeed Mr. Shacklett as power sales manager.

MORTIMER E. CORLEY, who retires this month as Dean of the Engineering and Architectural departments, University of Michigan, was guest of honor at a dinner on June 11 at the Book-Cadillac Hotel, Detroit, Mich., given by the university.

FRED T. HENSHAW, Portland, Oregon, district engineer in charge of water resources branch of the United States Geological Survey, has been transferred to the Federal Power Commission with headquarters in Washington, D. C. G. H. Canfield, who has been assistant district engineer under Mr. Henshaw for five years, will fill the vacancy caused by the latter's promotion.

W. H. WAKEMAN, an old-time contributor to *Power* and author of much helpful power-plant material, writes that fifty years ago this month he started a sawmill engine and has never been out of employment since. He has, however, helped many others to positions and by his writings and personal assistance helped them to make good. May he long continue to serve as chief engineer of the New Haven High and Boardman Trade schools.

A. G. CHRISTIE, Johns Hopkins University, sailed on the "Mauretania" on June 13 to spend the summer in England and on the Continent, in connection with some consulting work for clients abroad.

GORDON FOX, electrical engineer, and L. E. L. Thomas, vice-president of the Freyn Engineering Company, Chicago, sailed on May 30 on the "Aquitania" on their way to Russia in regard to engineering contracts in that country. Last year there was a contract signed by the Freyn Engineering Company, of Chicago, and the Supreme Council of National Economy of the United States of Soviet Russia, which provided for consulting, designing, construction, and supervising engineering services to the Soviet government in the development of its iron and steel industry over a period of five years.

JOHN H. BICKLEY, former chief auditor of the Public Service Commission of Maryland and former senior accountant of the Public Service Commission of Pennsylvania, has been engaged by the Federal Trade Commission as a member of its economic division staff investigating the financing of public utilities.

WILLIAM G. CHRISTY, for the last two years executive secretary of the Citizen's Smoke Abatement League in St. Louis, has tendered his resignation, effective July 1. As chairman of the St. Louis Section of the American Society of Mechanical Engineers, Mr. Christy, in February, 1926, was active in the organization of the Citizens' Smoke Abatement League, and was responsible for bringing to St. Louis O. P. Hood, chief engineer of the United States Bureau of Mines, who formulated the plan under which the League now operates. Prior to accepting a position with the League, he was superintendent of the St. Louis Boat & Engineering Company and during the War was district manager of the United States Shipping Board. Continuing his engineering activities, Mr. Christy is now national secretary of the Fuels Division of the American Society of Mechanical Engineers.

R. S. JULSRUD has resigned as service engineer with Combustion Engineering Corporation with headquarters at the Candler Building, Atlanta, Ga., and is now associated with the Fuel Efficiency Engineering Corporation, Birmingham, Ala.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except **Pittsburgh gas slack:**

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard...	New York.....	$2.40@$2.60
Kanawha.....	Columbus.....	1.25@ 1.60
Smokeless.....	Cincinnati.....	1.75@ 2.25
Smokeless.....	Chicago.....	1.65@ 2.00
S. E. Kentucky...	Chicago.....	1.25@ 1.50
Steam.....	Pittsburgh.....	1.40@ 1.80
Gas Slack.....	Pittsburgh.....	1.10@ 1.25
Big Seam.....	Birmingham....	1.40@ 1.75
Anthracite (Gross Tons)		
Buckwheat.....	New York.....	$2.75@$3.60
Birdseye.....	New York.....	1.60

FUEL OIL

New York—June 14, 28@34 deg., Baumé, industrial use, tank-car lots, 5¼c. per gal.; 36@40 deg., furnace, tank-car lots, 7¼c. per gal., f.o.b. Bayonne, N. J.

St. Louis—June 1, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.50 per bbl.; 26@28 deg., $1.55 per bbl.; 28@30 deg., $1.60 per bbl.; 30@32 deg., $1.65 per bbl.; 32@36 deg., gas oil, 4.3c. per gal.; 38@40 deg., 4.98c. per gal.

Pittsburgh—May 31, f.o.b. local refinery, 30@34 deg., fuel oil, 5¼c. per gal.; 36@40 deg., 5½c. per gal.

Philadelphia—June 13, 26@30 deg., $2.07 per bbl.; 13@19 deg., $1.22 per bbl.; 22 plus, $1.48@$1.55 per bbl.; 27@30 deg., $2.17 per bbl.

Cincinnati—June 11, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5¼c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—June 9, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.; 22@26 deg., 80c. per bbl.; 26@30 deg., 85c. per bbl.; 30@32 deg., $1.02½@$1.05 per bbl.

Boston—June 11, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.35c. per gal.; 28@32 deg., 5.65c. per gal.

Dallas—June 9, f.o.b. local refinery, 26@30 deg., $1.30 per bbl.

TRADE CATALOGS

SWITCHBOARD DEVICES—This 36-page catalog, No. GEA-924, of the General Electric Company, Schenectady, N. Y., lists busbar supports for indoor service. Dimensions, cantilever loadings, spacing between supports, prices, etc., are given. In a 20-page catalog of the same title, No. GEA-938, are listed accessories for switchboards, such as cable lugs, terminal blocks, wire cleats, rheostat mechanisms. A third bulletin, No. GEA-942, contains 54 pages and lists air-break switches, plugs and receptacles for switchboard mounting.

The Delta-Star Electric Company, 2400 Block, Fulton Street, Chicago, Illinois, has issued a new bulletin No. 31-RA describing a new line of low-voltage bus supports for voltages from 220 to 4,500. The fittings are interchangeable with higher-voltage supports listed in bulletin No. 31-B.

DESUPERHEATERS — In an 8-page 4-color booklet No. 6-D the Schutte-Koerting Company, Philadelphia, Pa., describes and illustrates two types of desuperheaters. One type uses water sprays as the desuperheating medium, while the other is of the surface absorption type. Several typical arrangements are shown, indicating methods of controlling the operation of the equipment.

SILICON-CARBIDE REFRACTORIES—The McLeod & Henry Company, Troy, N. Y., has issued bulletin No. 163, describing its new steel mixture, "Carbex," a refractory composed of 92 per cent silicon-carbide and 8 per cent steel mixture and having a decomposition temperature around 4,070 deg. F.

AIR COMPRESSOR—Bulletin No. 140, recently issued by the Pennsylvania Pump & Compressor Company, Easton, Pa., describes a multiple-belt-driven semi-portable air-compressor unit, arranged for automatic start and stop control. The outstanding features of this new unit are that it is self-contained and occupies limited floor space.

MECHANICAL DRIVEN TURBINES—Bulletin No. GEA-197A of the General Electric Company, Schenectady, N. Y., describes its type D-54 steam turbines for driving pumps, blowers and other classes of equipment. These machines are obtainable in sizes up to 500 hp. for either condensing or non-condensing operation.

CONDULET FITTINGS — The Adapti Company, 2996 E. 72nd St., Cleveland, Ohio, manufacturer of Adaptibox conduit fittings, has just issued supplementary catalog No. 107-A, describing a new line of adaptilets, (solid fittings); also fixture elbows, plug and base receptacles and self-aligning fixture joints for use with adaptilets, adaptiboxes and all regular standard fittings.

BALL BEARING VENTILATORS — The Swartout Company, Cleveland, Ohio, has just issued an attractive booklet number 12 K-1 entitled "The Gospel of Fresh Air." In this new edition the chief advantages of modern ventilation are set forth, together with illustrations of some of the numerous types of building and uses to which the ventilator is adapted, also line drawings showing typical ventilating systems.

OIL FUSE CUTOUTS—Catalog GEA-732 A of the General Electric Company, Schenectady, N. Y., is descriptive of that company's type D, D. & W. oil fuse cutouts. This publication has ten pages and includes many illustrations of the parts, assemblies and the fuses applications. Installation, operation and maintenance instructions are included, along with dimensions and prices.

THE AMES PUMP COMPANY, 90 West St., New York, a division of the Staten Island Ship Building Company, has appointed Yeomans Brothers Company, 1433 Dayton St., Chicago, to handle its line of vacuum heating pumps in Chicago and vicinity.

THE ALLIS CHALMERS MANUFACTURING COMPANY, Milwaukee, Wis., announces that the address of its office at Grand Rapids, Mich., is now 310 Broadway and Loan Building.

THE JOSEPH DIXON CRUCIBLE COMPANY announces that the new address of its Chicago office is 2003 Builders Building, Wacker Drive and LaSalle.

NEW PLANT CONSTRUCTION

Compiled by the McGraw-Hill Business News Department, which is prepared to furnish a more complete daily service to those who wish it

Ala., Albama City — City voted $70,000 bonds for the construction of a pumping station for water supply system.

Calif., Beverly Hills—California Bank is having plans prepared for a 6 story bank and office building including steam heating system, elevators, etc. Estimated cost $500,000. Walker & Eisen, Western Pacific Bldg., Los Angeles, are architects.

Calif., National City—Union Ice Co., San Diego, plans the construction of an ice plant here. Estimated cost $60,000. W. E. Flack is local manager.

Calif., Oakland—G. B. McInvoy, c/o W. H. Weeks, Hunter-Dulin Bldg., San Francisco, Archt., is having preliminary plans prepared for a 20 story office building at 14th and Harrison Sts. Estimated cost $1,500,000.

Conn., Hartford — Underwood-Elliott-Fisher Co., Capital Ave., awarded contract for the construction of a power plant to include 200 ft. stack, coal bunkers and automatic stokers, to Lockwood-Greene & Co., 24 Federal St., Boston, Mass. Estimated cost $300,000.

Fla., Tallahassee—State Bd. of Control, Jacksonville, will soon award contract for the construction of a dormitory and central heating plant for University of Florida here. Estimated total cost $300,000.

Ga., Tallapoosa — Alabama United Ice Co., Anniston, Ala., plans the construction of a 15 ton low pressure raw water ice plant here. G. E. Wells Inc., 100 West Monroe St., Chicago, Ill., are consulting engineers.

Ill., Chicago—Sanitary District of Chicago, 910 South Michigan Ave., awarded contract for the construction of West Side electric sub-station to Dowdle Bros., 228 North La Salle St. Estimated cost $2,087,450.

Ill., Downers Grove—Chicago Federation of Labor, 623 South Wabash Ave., is having plans prepared for a broadcasting station, including 50,000 w. generating station. Estimated cost $250,000.

Ill., Evanston—H. S. Jones, 1428 Noyes St., awarded contract for a 7 story co-operative apartment building at Hinman Ave. and Grove St., to C. E. Erickson, 4753 Broadway, Chicago. Estimated cost $1,250,000. Electric refrigeration system, etc., will be installed.

Ill., Galena — Supervising Architect, Treasury Dept., Washington, D. C., will receive bids until July 5 for the construction of a post office and boiler house here.

Ind., Evansville—George E. Wells, Inc., 100 West Monroe St., Chicago, Ill., Consult. Engrs., are receiving bids for the construction of a cold storage plant here for Evansville Ice & Storage Co., 10 North 8th St., Evansville, Ind.

Md., Baltimore—J. I. Goldstein, Calvert Bldg., plans the construction of a 12 story hotel and apartment building at 3700 Second St. Estimated cost $1,500,000. Architect and engineer not selected.

Mass., Attleboro—City awarded contract for the completion of a waterworks system including pumping station, etc., to Bruno & Petitti, 18 Tremont St., Boston. Estimated cost $245,000.

Mass., Boston—Bureau of Yards & Docks, Navy Dept., Washington, D. C., has been granted appropriation for extensions and improvements to power plant at Navy Yard here. Estimated cost $90,000. Private plans.

Mass., Boston — Massachusetts Catholic Order of Foresters, P. A. Walsh, High Chief Ranger, 17 Worcester St., plans the construction of a home. Estimated cost $1,000,000. Architect not selected.

Mass., Charlton — Masonic Assn., F. L. Simpson, Chn., awarded contract for the construction of a dormitory including power plant to Manchester Construction Co., 875 Main St. Estimated cost $150,000.

Mass., Holyoke—American Writing Paper Co., 9 Main St., is receiving bids for the construction of a boiler house, etc. Estimated cost $50,000. Private plans.

Mass., Maynard—Sewerage Commission is receiving bids for the construction of a sewage disposal plant and pumping station. F. A. Barbour, Tremont Bldg., Boston, is engineer.

Mich., Bay City—General Memorial Hospital, W. L. Clements, 506 Crapo Bldg., is having preliminary plans prepared for a 4 story hospital, including steam heating and ventilation systems, boilers, elevators, etc. Estimated cost $800,000. Pond, Pond, Martin & Lloyd, 6 North Michigan Ave., Chicago, Ill., are archietcts.

Mississippi—George E. Wells, Inc., 100 West Monroe St., Chicago, Ill., Consult. Engrs., are receiving bids for the construction of a cold storage warehouse at Jackson; making addition to ice plant at Crystal Springs, also plans a refrigerated retail icing station at Crystal Springs, for Southern United Ice Co., Jackson, Miss.

Mont., Great Falls — Bd. of Trustees, School Dist. No. 1, Cascade County, will receive bids about July 1 for the construction of a high school. Estimated cost $900,000. Bird & Van Teylinger are architects. Central fan system of heating and ventilating will be installed.

Mo., St. Louis—Laclede Power & Light Co., 11th and Olive Sts., awarded contract for a switch house on Mound St., to Woermann Construction Co., Syndicate Trust Bldg. Estimated cost $40,000.

N. J., East Orange—Advance Holding Co., H. Rothberg, Pres., 24 Branford Pl., Newark, will build a 10 story, apartment building including steam heating, ventilation and refrigeration systems, boilers, etc., at 32 South Munn Ave. Estimated cost $900,000. H. F. Clark, 38 Clinton St., Newark, is architect.

N. J., Jersey City—Public Service Electric & Gas Co., 80 Park Pl., Newark, will build an electric transformer station at 109 Morgan St., here. Estimated cost $55,000. Public Service Production Co., 80 Park Pl., Newark, is engineer.

N. Y., Brooklyn—Pierrepont Hotel Corp., M. E. Morris, 1900 Broadway, New York, awarded contract for a 16 story hotel and club building at 55-57 Pierrepont St., to Fredbern Construction Corp., 7 East 44th St., New York. Estimated cost $2,000,000.

N. Y., Castle Point—U. S. Veterans Bureau, Room 764, Arlington Bldg., Washington, D. C., will receive bids until June 26 for the construction of a steam distribution system at U. S. Veterans Hospital here.

N. Y., New York—Fairview Gardens, Inc., 4671 Delafield Ave., had plans prepared for a 7 story apartment building at 230th St. and Spuyten Duyvil. Estimated cost $900,000. Private plans.

N. Y., New York—Fifty-Five East Tenth St. Corp., H. Mandel, Pres., 1 Park Ave., had plans prepared for a 15 story hotel. Estimated cost $750,000. Farrar & Walmouth, 1 Park Ave., are architects.

N. Y., New York—G. A. F. Realty Corp., H. S. Black, Pres., 11 Broadway, awarded contract for a 35 or 37 story office and stores building at Madison Ave. and 57th St., to G. A. Fuller Co., 949 Broadway. Estimated cost $5,000,000.

N. Y., New York—Garfield Electric Supply Co., 147 West 23rd St., will receive bids about Aug. 1 for a 16 story office and loft building. Estimated cost $1,250,000. Architect not announced.

N. Y., New York—One Thousand Two Hundred Fifth Ave. Corp., H. Fischel, Pres., 276 5th Ave., awarded contract for a 15 story apartment building at 5th Ave. and 101st St., to Ravitch Bros. Construction Co., 26 5th Ave. Estimated cost $1,000,000.

N. Y., New York—J. Schwartz, 475 5th Ave., will receive bids about August 1 for the construction of an apartment building at 144 West 86th St. Estimated cost $800,000. J. M. Felso,., 250 West 57th St., is architect.

N. Y., New York—Ten West Eleventh St. Corp., M. Ginsberg, Pres., 247 Park Ave., had plans prepared for a 15 story apartment building. Estimated cost $1,000,000. Van Wart & Wein, 347 Madison Ave., are architects.

N. C., Rocky Mount—City is having surveys made for increasing power facilities at Rocky Mount. W. M. Piatt, Durham, is engineer.

O., Youngstown—City awarded contract for the construction of a hospital including main building, nurses' home, boiler plant, etc. to Joseph Bucheit & Son Co., 100 East Rayen St. Total estimated cost $1,600,000.

O., Youngstown—Youngstown Hospital Assn., c/o J. Tod, 44 Central Sq., will soon award contract for the construction of a hospital. Estimated cost $800,000. Al Kahn Inc., Marquette Bldg., Detroit, Mich., is architect and engineer.

Okla., Norman—New State Ice Co., 2 West Third St., Oklahoma City, is having plans prepared for the construction of an ice plant here. Estimated cost $75,000.

Ore., Eugene—Eugene Water Board, C. A. McClain, Supt., received lowest for the construction of Leaburg Hydro-Electric Development, Cont. F.; headworks, Cont. G. canal and tailrace, and Cont. H. forebay, penstocks, siphons and power house No. 2 from A. Guthrie & Co., Sherlock Bldg., San Francisco, Calif. Total $1,029,231.

Pa., Philadelphia—City plans the construction of a morgue including an ice plant at 13th and Wood Sts. P. H. Johnson, Widener Bldg., is architect.

Pa., Philadelphia—Strawbridge & Clothier, 801 Market St., awarded contract for a 14 story department store to Turner Construction Co., 1700 Walnut St. Estimated cost $6,000,000.

Pa., Wilkes-Barre—Wilkes-Barre Deposit & Savings Bank, 71 Public Sq., will soon award contract for a 12 story office building at 65 Public Sq. Estimated cost $1,000,000. McCormick & French, Second National Bank Bldg., are architects. B. Cunningham, 7 Dey St., New York, N. Y., is associate architect.

Tenn., Kingsport—City, F. L. Cloud, Mgr., will receive bids until June 26 for extensions and improvements to waterworks including 2 m.g.p.d. filtration plant, raw water pumping station, etc. Wiedeman & Singleton, Candler Bldg., Atlanta, Ga., are engineers.

Tex., Amarillo—Panhandle & Santa Fe Ry. Co. awarded contract for excavation for a 12 story office building at 9th and Polk Sts. Estimated cost $1,000,000.

Tex., Denton—City plans an election about June 16 to vote $40,000 bonds for the construction of an ice plant. Private plans.

Tex., San Antonio—Alamo National Bank, c/o E. L. Borwn, V. Pres., 128 West Commerce St., plans the construction of a 22 story bank and office building at St. Marys and Commerce Sts. Estimated cost $1,000,000. Architect and engineer not selected.

Wash., Tacoma—Donnelly Hotel-Apartment Co., plans the construction of a 6 story hotel at 6th St. and Broadway. Estimated cost $1,000,000.

B. C., Hastings—British Columbia Electric Railway Co., 425 Carral St., Vancouver, awarded contract for first unit of steam generating plant (standby) 20,000 kw. capacity to include wharves, coal handling equipment, etc., at Burrard Inlet here, to C. C. Moore & Co., 510 Hastings St. W., Vancouver. Estimated cost $2,000,000. Ultimate total capacity of plant 80,000 kw. Pulverized coal to be used.

Equipment Wanted

Air Compressor, Transformers, etc.—Central Bd. of Purchases, Milwaukee, Wis., will receive bids until June 20 for five portable air compressors, four multi-trap transformers, etc.

Boilers, Stokers, Turbine and Generator—P. H. Hanes Knitting Co., Winston-Salem, N. C., plans to purchase two tube boilers with automatic stokers, one 1,000 hp. bleeder type steam turbine direct connected to generator for proposed power plant and mill.

Deaerating Apparatus, Blow-Off Equipment, Condenser, etc.—Bureau of Yards & Docks, Navy Dept., Washington, D. C., will receive bids until June 23 for deaerating apparatus and continuous blow-off equipment consisting of deaerator, condenser, feed water storage tank, heat exchangers, blow-off control devices, etc., also alterations to boiler house at Marine Barracks, Parris Island, S. C.

Electric Motors, Conveying and Unloading Equipment, etc.—H. W. Rickel & Co., 1824 Adelaide St., Detroit, Mich., plans to purchase electric motors, conveying and unloading equipment for handling grain for proposed grain elevator. Estimated cost $125,000.

Power House Equipment, Steam Lines, etc.—Dept. of Public Welfare, Pittsburgh, Pa., will receive bids until June 21 for furnishing and installing power house equipment, steam lines, etc., at City Home and Hospital, Mayview, Pa.

Pump—U. S. Veterans Bureau, Room 764, Arlington Bldg., Washington, D. C., will receive bids until June 28 for the installation of a deep well pump at U. S. Veterans Hospital, Walla Walla, Wash.

Pump, etc.—City of Julian, Neb., plans to purchase a pump, etc., for proposed waterworks improvements.

Pump, etc.—City of Lincoln, Neb., plans to purchase a deep well turbine pump for University Place pumping station.

Pumping Units—Commission Council, City Hall, New Orleans, La., will receive bids until June 26 for two 2,500 g.p.m. sewage pumping units and auxiliary equipment.

Pumps—City of Hobart, Okla., plans to purchase motor driven centrifugal pumps, etc., for proposed waterworks improvements. Estimated cost $46,000.

Pumps—City of Ord, Neb., W. E. Walters, Clk., pumps, etc., for proposed waterworks improvements. Estimated cost $38,000.

Pumps, etc.—City of Highland Park, Ill., will receive bids until July 9 for electrically operated pumps and gasoline engine standbys for proposed waterworks improvements. Estimated cost $300,000.

Transformers—Modesto Irrigation Dist., Modesto, Calif., C. S. Abbott, Secy., will receive bids until July 2 for four 1,667 kva. outdoor type transformers for operation at 66,000 v., star to 11,500 v. Delta.

Industrial Projects

Calif., Los Angeles—ASSEMBLY PLANT—Willys-Overland Co., c/o J. A. Sheldon, 439 Biltmore Hotel, awarded contract for a group of buildings for assembly plant, including boiler house, etc., on Randolph St., to W. P. Neil Co., 4814 Loma Vista Central Mfg. Dist. Estimated cost $150,000.

Calif., Vernon—GLASS FACTORY—Illinois-Pacific Glass Co., 15th and Folsom Sts., San Francisco, awarded contract for the construction of a group of buildings for glass factory to W. P. McNeil Co., 4814 Loma Vista Ave., Los Angeles. Estimated cost $400,000.

Conn., New Haven—FACTORY—Western Electric Co., 80 John St., awarded contract for a 2 story factory to T. J. Pardy Construction Co., 1481 Seaview Ave., Bridgeport. Estimated cost $50,000.

Conn., Torrington—AUTO ACCESSORY and SUPPLY FACTORY—The Dayton Mfg. Co., plans the construction of a 2 story addition to plant.

Ind., Anderson—RAW FELT FACTORY—Certainteed Products Co., 100 East 42nd St., New York, N. Y., have acquired the plant of the Beaver Products Co., here and plans to remodel fourteen buildings to include boiler room, etc. for the manufacture of raw felt for roofing. Estimated cost $40,000. W. R. Cady, is local manager.

La., Houma—SUGAR CANE MILL—Pipes & Krumbhaar awarded contract for the construction of a sugar cane mill including boiler house, etc.

Md., Canton (mali Baltimore)—FERTILIZER PLANT—American Agricultural Chemical Co., Lexington Bldg., Baltimore, awarded contract for the construction of a 3 story, 169 x 201 ft. plant, including 69 x 70 ft. storage building, 45 x 69 ft. manufacturing building, laboratory building, etc., to Consolidated Engineering Co., 20 East Franklin St., Baltimore. Estimated cost $200,000.

Md., Fairfield (Station Baltimore)—OIL REFINERY—Prudential Refining Corp., Baltimore, is having plans prepared for the construction of an oil refinery here. Estimated cost $2,000,000.

Mass., Webster—SPINNING FACTORY—Maanexit Spinning Co., North Main St., awarded contract for a 1 and 2 story, 70 x 120 and 40 x 62 ft. factory to L. A. Murphy, 112 North Bend, Pawtucket, R. I. Estimated cost $65,000.

Mich., Detroit—PAPER WAREHOUSE—F. L. Bromley Properties, Inc., 6531 Russell St., will soon award contract for a 2 story, 190 x 220 ft. warehouse including boiler house on Milwaukee Ave. Estimated cost $250,000. A. Kahn, 1000 Marquette Bldg., is architect.

Mo., St. Louis—WAX PAPER PLANT—Waxide Paper Co., Berkowtiz Ave., 20th and Tracy Sts., Kansas City, awarded contract for the construction of a 1 story, 150 x 267 ft. wax paper plant at Newstead St. between Hunt and Race Course Aves., to Fruin-Colnon Contracting Co., 501 Merchants Laclede Bldg. Estimated cost $250,000.

N. Y., Binghamton—PHOTOPRODUCTS FACTORY—Afga Ansco Mfg. Co., H. W. Davis, Pres., 23 Charles St., awarded contract for the construction of a factory to Turner Construction Co., 11 Goodell St., Buffalo, N. Y. Estimated cost $600,000.

N. Y., Brooklyn—GAS BY-PRODUCTS HOUSE—Union Gas Co., 176 Remsen St., awarded contract for the construction of a gas by-products house at Gardner and Maspeth Aves. to Bartlett-Hayward Co., 200 Scott St., Baltimore, Md. Estimated cost $500,000.

Pa., Vernon—RAYON FACTORY—Viscose Co., Marcus Hook, Pa., plans the construction of a factory here. Estimated cost $1,000,000. Ballinger Co., 12th and Chestnut Sts., Philadelphia, is architect.

Tex., El Paso—COPPER REFINERY—Nichola Copper Co., 25 Broad St., New York, N. Y., subsidiary of the Phelps Dodge Corp., 99 John St., New York, will build an electrolytic copper refinery 100,000 ton annual capacity here. Estimated cost $3,000,000. Work will be done by day labor.

Tex., Houston—PACKING HOUSE—Burton Packing Co., awarded contract for a 2 story, 60 x 138 ft. packing house at Clark and Bay Sts. to C. C. Rhodes, 1656 Marshall St. Estimated cost $100,000.